CAMERON'S
HANDY-BOOK
ON
FOOD AND DIET.
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A HANDY BOOK ON FOOD AND DIET, IN HEALTH AND DISEASE.

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PREFACE.

THE following pages contain a brief account of the present state of our knowledge relative to the composition of food, and the functions which it performs in the animal body.

The results of recent investigations have shed new light on the processes of nutrition, and have modified long entertained opinions as to the means by which the heat and energy of our bodies are maintained. The object of this little Work is partly to explain the newest views relative to the physiology of digestion, and the comparative values and modes of action of food substances; partly to present to the public a cheap and plainly written book on Food and regimen.

TO

SIR DOMINIC J. CORRIGAN, BART., M.D., M.P.,

Ex-President of the King and Queen's College of Physicians in Ireland; Physician in Ordinary to Her Majesty the Queen, &c., &c., &c.

MY DEAR SIR DOMINIC,—

In permitting me to inscribe to you this little book, you add another to the favours which you have conferred upon

Yours, dear Sir Dominic,

Very faithfully and obliged,

CHARLES A. CAMERON.

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HANDY BOOK ON FOOD AND DIET.

CHAPTER I.

NATURE AND FUNCTIONS OF FOOD.

THE world, so far as we have been able to discover, is composed of about sixty-two distinct substances, termed *elements*, or *simple bodies*. Gold and sulphur are elements, and are met with in nature in an uncombined state; but the great majority of the elements are found combined with each other in different proportions. For example, chalk contains three elements—a metal, termed calcium, a solid body called carbon (identical with the diamond, charcoal, and black lead), and a gas (when free) named oxygen. Any bodies that we can decompose so as to extract other kinds of matter from them are *compounds;* those from which only one kind of matter can be obtained are *elements.* We cannot take anything out of iron save iron, because that metal is an element; but by means of the processes of chemical analysis we are able to extract from alum four distinct kinds of matter, namely, sulphur, oxygen, and the metals aluminium and potassium.

A large number of the elements occur in extremely minute quantities, and not more than a dozen are comparatively abundant. With the exception of aluminium, all the more abundant elements are found in animal and vegetable

substances. Oxygen, hydrogen, and nitrogen are gases in their free state; but when combined with each other, and with the solid element, carbon, in various proportions, they constitute an immense variety of compounds—mineral, vegetable, and animal. By far the greater part of food is composed of these elements. The other simple bodies found in plants and animals are sulphur, phosphorus, chlorine, potassium*, sodium, calcium, magnesium, and iron. Silicon, the basis of flint, is found in some kinds of plants; but it is not essential to animal life; and fluorine, iodine, bromine, cæsium, rubidium, lithium, and even a few of the poisonous metals—such as lead and copper—though often found in plants, are in all probability merely accidentally present.

Animals do not possess the power of converting the elements found in the mineral kingdom into their own bodies; therefore, they are wholly dependant for their supply of nutriment upon the vegetable creation. It is the great function of plants to convert mineral matter into those highly complex substances termed *organic*, some of which constitute the nutriment upon which the whole animal kingdom subsists. The vegetable *organizes*, the animal *disorganizes*. The plant takes into its mechanism mineral matters, the constituents of which it recombines, so as to produce from them sugar, starch, woody fibre, and the various other substances termed *vegetable*. The animal takes into its organism vegetable substances, reorganizes them into its tissues, or structures, and subsequently disorganizes them, and reduces them to their original mineral condition.

A plant grows by the assistance of light and heat; and it is believed that when mineral matter becomes vegetable

* Potassium and oxygen form oxide of potassium, or potash, soda is the oxide of sodium, lime is the oxide of calcium, magnesia the oxide of magnesium. Sulphur and phosphorus exist in food chiefly in the form of sulphuric acid and phosphoric acid, and united with various metals.

matter the heat and light under the influence of which the change had been effected become stored up in the vegetable matter. In this way we account for the fact that when wood is burned we obtain light and heat; and it explains how it is that combustion of coal (which is partly decayed vegetable matter) supplies the force by means of which the huge locomotive is impelled with almost lightning speed. As animals are obliged to roam about in quest of food, and as the temperature of their bodies must be kept up to about 100 deg. Fahrenheit, no matter how cold the air is, we see how necessary it is that they should be well supplied with heat and motive power. Food is not alone used for the purpose of forming and repairing the animal body—it is also intended to supply it with heat and with motive power.

CHAPTER II.

PROXIMATE CONSTITUENTS OF FOOD.

We have seen that the elementary constituents of food are but very few in number: the same simplicity prevails with respect to its more important proxiate ingredients. If we except the substances which confer flavour and odour upon food, and which exist in minute quantities, our ordinary nutriment is made up of but very few distinct substances. If we exclude water—which constitutes from 5 to 94 per cent. of the weight of different kinds of food—the most abundant nutritive material is *starch*. This body consists of somewhat flattened ovate grains, which in most plants are marked by a series of concentric rings. They vary in size from thy 200th to the 3,500th part of an inch in diameter, accord-

ing to the plant which yields them. Starch when heated to 400° Fahrenheit is converted into British gum, or dextrin; and when heated with dilute sulphuric acid, or mixed with a fermentiscible body, it is soon changed into a sweet substance termed grape sugar, which is identical with that found in fruits and malted corn. There is 15 per cent. of starch (out of the 25 per cent. of solid matter found) in the potato. Rice contains 82, wheat 60, and turnips 5 per cent. of starch; and arrow root, *tous les mois*, and tapioca are wholly composed of starch and water.

There are about a dozen substances termed *sugars*, which are nearly identical in composition, and strongly resemble the common (cane) sugar. *Saccharose*, *cane*, or ordinary sugar, consists of little white transparent crystals; it occurs abundantly in the sugar cane, beet root, the sugar maple, carrots, pumpkins, and various other plants. *Glucose*, or *grape sugar* forms very small cubic crystals; it is inferior in colour to cane sugar, and possesses less than one-half the sweetening power of the latter. It is found in grapes, figs, and other fruits, and in honey. *Lævulose* or fruit sugar is identical in composition with grape sugar, but it is even sweeter than cane sugar. It occurs in sweet fruits, in honey, and in molasses. It does not crystallize. *Vegetable mucilage* is found in almost every kind of plant, and largely in flax and other seeds. It resembles gum very closely. Cellulose, which forms the cellular, or fundamental tissue of plants, and which in a modified state constitutes common wood, resembles starch in composition, and is convertible into grape sugar by the action of sulphuric acid. Some of the lower animals are able to digest cellulose, but it is not suitable food for man. The *pectose* bodies, which include *pectose*, *pectin*, and *pectosic*, *pectic*, and *metapectic* acids are generally diffused throughout the vegetable kingdom. They are most abundant in fleshy fruits, but they constitute

no inconsiderable proportion of the nutritive matter found in roots and foliage. The chemisty of pectose bodies is not, as yet, thoroughly investigated; but there is no doubt that they are nutritious substances, probably equal to starch or sugar. Pectose is termed vegetable jelly, because it is owing to its presence that the juices of various fruits gelatinize.

Gums are commonly met with in plants. They are most probably nutritive substances; but the point is a disputed one.

Inulin closely resembles starch, and to a great extent replaces that substance in several roots—those of the dandelion, artichoke, and chicory, for example.

Dextrin occurs—but only in minute quantities, and under certain conditions—in various plants. During the malting of corn it is produced in great abundance from the starch of the grain. The sugars, starches, and pectose bodies are, there is reason to believe, about equal in nutritive power. Many of them are absolutely identical in their ultimate chemical composition. Cellulose, starch, inulin, vegetable mucilage, and dextrin have exactly the following centesimal composition:—Carbon, 44.44; hydrogen, 6.17; oxygen, 49.39 = 100. Grape and fruit sugars are also identical in composition, each being composed of—carbon, 40.00; hydrogen, 6.67; oxygen, 53.33 = 100. Cane sugar is identical with some of the gummy bodies; it is composed of 42.11 parts of carbon, 6.43 of hydrogen, and 51.46 of oxygen = 100. Pectin is composed of—carbon, 40.67; hydrogen, 5.08; oxygen, 55.25 = 100.

The members of the cellulose, starchy, saccharine, and pectose group of aliments are termed *carbo-hydrates*, because they are composed of carbon, united with hydrogen and oxygen—the latter two being present in the same proportions that they exist in water.*

* This does not apply to the pectose bodies. Hydrated means that water is present.

The vegetable acids are composed of carbon, hydrogen, and oxygen. They are numerous; but only five of them are interesting in connection with the subject of food: these are *tartaric, citric, malic, acetic,* and *oxalic* acids. Malic acid is abundant in apples, plums, gooseberries, cherries, currants, and most of the common fruits. It is found also in the garden rhubarb and in various wild berries. Tartaric acid occurs largely in the grape, and is found in pine apples and other fruits, and in the potato and other tubers. Citric acid is largely present in the lemon, and it is generally associated with malic acid in the ordinary fruits. Oxalic acid is found in most plants; but it occurs abundantly in the garden rhubarb and sorrel. Acetic acid, or vinegar, is very rarely present in living plants; but it is frequently produced when their juices are fermenting. All these acids exist in plants combined with metals—potassium, &c.—which neutralize their sour taste; but they are often in a free state, and hence render the vegetable juices acid. The chief dietetic value of the vegetable acids is their anti-scorbutic property, which is very remarkable.

Oils and fats are, like the preceding groups of food substances, composed of carbon, hydrogen, and oxygen; but they contain relatively more carbon and hydrogen. They are widely distributed throughout the vegetable kingdom, and are particularly abundant in the seeds of plants. The fats that are of interest as food substances are stearin, palmitin, and olein. These consist of fatty acids (so-called; but they are not sour), united with glycerin. When stearin, or any similar fat, is boiled with potash or soda, the alkali unites with the fatty acid, forms with it a soap, and sets free the glycerin. Olein is a fluid fat, and is largely present in oils. Palmitin occurs in butter, in palm and other oils, and in fats and wax. Stearin is the chief fat in tallow, and is the most abundant of the fatty bodies.

COMPOSITION OF THE FATS.

	Stearin.	Olein.	Palmitin.
Carbon	76.6	75.9	77.4
Hydrogen	12.4	12.2	11.8
Oxygen	11.0	11.9	10.8
	100.0	100.0	100.0

In nutritive power, 1 part of fat is equal to $2\frac{1}{2}$ parts of starch or sugar.

The fats and the carbo-hydrates are alone incapable of forming flesh or bone, because they do not contain nitrogen, sulphur, and phosphorus. The fats and carbo-hydrates supply only three of the elements necessary to the building up of the animal body; the others are furnished by the *albuminoid*, or nitrogenous group and the saline elements of nutrition. The chief albuminoids are albumin, fibrin, and casein. Albumin is an uncrystallizable solid. It is soluble in water up to 140 degrees Fah., at which temperature it coagulates, *i.e.*, becomes insoluble. It is found in the juices of plants, often in great abundance. Fibrin is not abundant in vegetables; it is rather a hard, horny substance. The gluten of wheat flour is chiefly composed of albumin and fibrin. Vegetable casein is very abundant in the pea and bean. There are various other albuminoids, but they all resemble each other so closely that many chemists believe them to be identical in ultimate composition. It is very remarkable that two or more distinct substances should possess the same elementary composition. The difference in properties appears to be due to differences in the arrangement of the particles of matter composing each substance.

COMPOSITION OF ALBUMINOIDS.

	Carbon.	Oxygen.	Hydrogen.	Nitrogen.	Sulphur and phosphorus.
Albumin	53.4	23.0	7.1	15.6	0.9
Vegetable fibrin	54.3	20.6	7.2	16.9	1.0
Vegetable casein	53.9	23.0	7.2	15.0	[illegible]

Albumin, fibrin, and casein are abundantly present in animal substances, but they do not differ in any important respect from the vegetable substances of the same name. Gelatin is a nitrogenous substance; but it does not contain phosphorus, and probably includes but little, if any, sulphur. Its nutritive properties have been called in question, but it is, in my opinion, decidedly entitled to be ranked amongst the food principles. It does not occur in the vegetable kingdom.

The fats stearin, palmitin, and olein, which form the fatty tissues of animals, are essentially the same substances as the stearin, palmitin, and olein of the vegetable kingdoms. In the brain and nerves, fats containing phosphorus occur, and similar fats have been lately discovered in various vegetables.

The saline matters which are used as food are generally found associated with the albuminoids. They are composed of potassium, sodium, calcium, magnesium, and iron, with chlorine and phosphoric, sulphuric, and organic acids. Common salt (a compound of chlorine and the metal sodium) is the only mineral food, except water, for which animals have an instinctive longing.

CHAPTER III.

VEGETABLE FOODS.

The most valuable and generally used vegetable food is that derived from the grains of the cereal plants—the wheat, oat, barley, rye, rice, &c. Wheat flour is by far the best material for the manufacture of fermented bread. Oatmeal

is not adapted for bread-making: but it forms excellent cakes; and in the form of porridge it constitutes the staple food of the Scotch agricultural labourers, and that of the great majority of the English agricultural labourers. It is also largely used in Ireland. Barley flour cannot be well made into bread, unless when mixed with wheat flour. Barley meal is an economical food; but, weight for weight, it is inferior to both wheat flour and oatmeal. It is best used in the form of stirabout, or porridge. Rye is but little used now in the United Kingdom; but it is one of the most common breadstuffs in the north of Europe. It is inferior in every respect to wheat. Indian corn is a nutritious grain, but, although a very cheap and very nutritious food, its want of flavour renders it the least favorite food used by the lower classes. It is best used in the form of stirabout; for the bread made from it is very unpalatable. Rice is the least nutritious of the food grains; but it is well flavoured and very digestible.

Bread and biscuit are in Great Britain chiefly prepared from the flour of wheat. The seed, or grain of the wheat is resolved by the processes of grinding and sifting into *flour*, *sharps*, *pollards*, and *bran*. One hundred parts of grain yield from 62 to 87 parts of flour and from 13 to 38 parts of bran, according to the thickness of the husk, or covering of the seed. In general the percentage of bran is not more than ten. There are usually two qualities of flour. Fine flour, or *firsts*, contains no bran; in *seconds* there is a small proportion of bran, which renders the colour of the flour a little darker than that of the firsts. Sharps contain a rather large proportion of bran, and are generally reground and resolved into flour and bran. Pollards are largely composed of the husk of the grain, and are only fit food for the lower animals. Bran consists chiefly of husks, but it is found impossible to separate it wholly from the farina, or flour, at least

by the millers' processes. From the first quality of flour the whitest and nicest bread is manufactured; but the second forms the most economical breadstuff, and produces a well-flavoured loaf. Wheat grain, ground, but unsifted, or ordinary flour mixed with a little bran, are made into ***brown bread.*** This food is richer in albuminous matter than white bread; but a considerable proportion of it is indigestible. Working men prefer white bread to brown, not on account of superior flavour, but because of its greater economy. Brown bread is, in fact, better suited to the sick than to the poor; and its laxative properties recommend it to many persons. It is the bran in brown bread which is indigestible; but it has lately been discovered that from this constituent of grain a large proportion of soluble, easily digestible, and highly nitrogenous substance, termed ***cerealin***, may be obtained. An excellent preparation termed "Chapman's Entire Wheat Flour" has recently been introduced by Mr. Orlando Jones, of London. It contains nearly all the cerealin, and the phosphates originally present in the grain.

Bread is prepared by laboriously kneading flour with water, salt, and yeast, and allowing the very soft dough (sponge) so prepared to remain for some time in a trough placed in a warm situation. This process is termed ***setting the sponge.*** In a short time the yeast (a highly nitrogenous substance in a state of fermentation) begins to act upon the flour; part of the starch becomes sugar, which in turn is changed into alcohol, with simultaneous production of carbonic acid, which puffs up the dough by filling its cavities with gas. After some time more flour, water, and salt are added to the dough; a second kneading takes place, and again the mass is allowed to remain for some hours in a warm place. Finally the dough, which is now swollen very much and full of air bubbles, is divided into weighed portions, and soon after heated, or ***baked*** in an

oven. 280 lbs. of flour yield from 360 to 405 lbs. of bread. The yeast employed in bread making should be sweet, the dough should be thoroughly kneaded, and the temperature of the oven should not be lower than 212 degrees Fahrenheit.

Baking powders for dispensing with the fermentation of the dough are chiefly composed of a mixture of one part of tartaric acid, two parts of bicarbonate of soda (hydrosodic carbonate), and three or four parts of flour. When this mixture is wetted, carbonic acid is disengaged, which vesiculates the dough. The baking process must be at once proceeded with; otherwise the inflated dough will soon subside into its original size.

Badly made and sour bread gives rise to various kinds of dyspepsia. Good bread should not be *sodden*, or heavy, and the cavities should be regular throughout the crumb—large holes generally indicating defects either in the yeast, in the kneading, or in the baking. The crust should form about one-fourth of the weight of the loaf, and it should be thoroughly baked, but not burnt. Bread not well baked is less digestible than well-baked bread. The disadvantages of a purely bread diet are the relative deficiencies of its nitrogenous and fatty elements. The deficiency is, however, very slight with respect to nitrogen; but it is a decided shortcoming in the case of the fats. Butter and rich cheese are the proper additions to a bread diet. Bread and meat of moderate fatness also consort well.

Biscuits are made both from fermented and unfermented dough. The latter are chiefly used by sailors. There are a great variety of biscuits made from dough wholly or partly fermented, and containing variable quantities of sugar, milk, butter, eggs, and spices. The following are the formulæ according to which several kinds of biscuits are prepared:—

	Flour, 280 lbs.	Water or Milk, Quarts.	Butter, Lbs.	Sugar, Lbs.	Eggs.
Captains		10	15		
Machine		$5\frac{3}{4}$	58	14	
American		10	40	17	
Coffee		$8\frac{3}{4}$	17		140

The celebrated Shrewsbury cakes are made with 280 lbs. of flour, 93 lbs. of butter, 93 lbs. of sugar, 93 eggs, and a little flavouring matter—cinnamon, mace, &c.

When of good quality, bread contains about 38 per cent. of water, 8 to 10 per cent. of nitrogenous substances, $1\frac{1}{2}$ per cent. of fats, and from 55 to 58 per cent. of gum, dextrin, sugar, and starch—the latter generally constituting three-fourths of the solid ingredients of bread. Biscuit, if plain, closely resembles bread in every respect, save one—its low proportion of water, which often is less than seven per cent. Soft biscuits contain large proportions of water.

Peas and beans contain about one-fourth of their weight of nitrogenous matter—chiefly legumin, which resembles the casein of milk. They were formerly esteemed on account of their high proportion of albuminoids—the most concentrated form of vegetable food; but as the value of foods is no longer estimated by their proportion of nitrogen, we cannot regard peas or beans as aliments superior to wheat or oats. They are, however, foods of a most valuable kind, and they consort well with butter and other fatty aliments.

Amongst roots and tubers, the potato occupies the highest place. It contains 25 per cent. of solid matters, of which four-fifths are carbo-hydrates, and the rest albuminoids, fats, and saline matter. Its anti-scorbutic properties and easy digestibility are remarkable. The potato is alone capable of supporting life; but as it is very deficient in fats, the addition of butter or other fatty matter to a potato diet is most desirable. The parsnip is an excellent vegetable. It contains about 18 per cent. of solid matters, which, however, includes a larger proportion of the useless cellulose than is

found in the potato. The carrot somewhat resembles the parsnip; but it contains little, if any, starch: three parts of parsnip fully equal four parts of carrot. White turnips contain from 90 to 94 per cent. of water: they are not, therefore, nutritious food.

Amongst the plants used on account of their leaves, the varieties of the cabbage are the most common. They contain only about five per cent. of solid matter, of which a large proportion is in a semi-organized state, and is, therefore, indigestible. The large quantity of saline matter present in fresh, or succulent vegetables is their chief recommendation.

Fruits are used as a staple food in many warm countries; but in most parts of Europe they are regarded chiefly in the light of luxuries. Deprived of their stones, or seeds, they contain often not more than five per cent. of solid matter. They are very poor in albuminoids; but they are usually rich in sugar, and many of them contain much acid. There is the greatest variation in the relative amounts of pectose, sugar, and acid in edible fruits. Berries contain, as a rule, more acid than stone fruit. The grape contains from 13 to 20 per cent. of sugar; the cherry only $1\frac{1}{2}$ per cent. In the peach there is about 9 per cent. of soluble pectin and gum; whilst the gooseberry includes only 2 per cent. of these bodies. In the common fruits the percentage of free acid varies from a mere trace to about 3 per cent. The pear is almost wholly free from acids, whilst the currant often contains three times as much free acid as sugar. The grape is probably the fruit best adapted for the sick. As heat and force producing foods, $5\frac{1}{2}$ lbs. of grapes, $6\frac{3}{5}$ lbs. of apples or cherries, $10\frac{3}{4}$ lbs. of currants, and $12\frac{1}{3}$ of strawberries are equal to one pound of starch. The dietetic value of the fruits is chiefly due to their fine flavour and their abundance of saline matter. The juice of limes and lemons is extensively

used by sailors for the purpose of counteracting the scurvy-producing influences exercised by their salt junk.

Sugar and treacle are respiratory, or heat-producing and fat-making foods; but they do not contribute to the formation of bone or muscle. Owing to their solubility and good flavour, they are readily digestible by most persons, and they are especially esteemed by the young. Treacle possesses greater sweetening power than crystallized sugar.

Arrowroot, tapioca, and the different "corn flours" are varieties of starch. They are, like sugar, incapable of nourishing all the tissues; but combined with milk and other articles, they constitute valuable and readily digestible nutriment.

The composition of the more important vegetable foods is shown in the table, page 57.

CHAPTER IV.

ANIMAL FOOD.

THE structure of the organs of nutrition in man shows clearly that he is designed by nature to eat both animal and vegetable food; and the immense majority of mankind consume—if they can afford it—the flesh of animals. The flesh of the ox, freed as far as possible from blood vessels and fat, contains about three-fourths of its weight of water and one-fourth of solid matter. The chief part of lean flesh consists of bundles of elastic fibres (muscular tissue) enclosed in albuminous sheaths, composed of little vessels termed cells. The fibres are bathed in water, fatty substances, soluble albumin, and a complex substance termed the juice, or extract of flesh. The muscular fibres constitute about 15 per cent.

of lean flesh, and the rest is made up of albumin, fat, gelatinous (resembling gelatin) substances, creatin, creatinin, inosinic acid, and various salts. The extractive matter is very complex, and its exact composition is not yet thoroughly known. The ash is the part which is left when flesh is burned; it is chiefly composed of phosphoric acid and potash. The red colour of flesh is due to the blood which is diffused through it.

The carcasses of the animals used as human food contain more fat than lean flesh. The fatter meat is, the less is the proportion of water present. Fat meat is, therefore, more economical than lean meat, provided, of course, that the consumer is fond of the fatty parts and is able to digest them. The composition of the whole carcasses of oxen, sheep, and pigs in different conditions has been determined very accurately by Lawes and Gilbert. It is shown in the following table:

Centesimal Composition of Animal Carcasses, exclusive of Offal.

(According to Lawes and Gilberts' analyses.)

	Water.	Lean Flesh.	Fat.	Salts.
Fat Calf ...	62.3	16.6	16.6	4.5
Half-fat Ox ...	54.3	17.6	22.6	5.5
Fat Ox ...	45.6	15.	34.8	4.6
Fat Lamb ..	48.6	10.9	36.9	3.6
Store Sheep ...	57.4	14.5	23.8	4.3
Half-fat do. ...	49.7	14.9	31.3	4.1
Fat do. ...	39.7	11.5	45.4	3.4
Very fat do. ...	33.1	9.1	55.1	2.7
Store Pig ...	55.3	14.1	28.1	2.5
Fat Pig ...	38.6	10.5	49.5	1.4

The offal, or unusable and inferior part (liver, lungs, &c.) of the fat ox makes up 38.5 per cent. of its weight; of the store ox, 38.9 per cent.; of the fat calf, 33½ per cent.; of the store sheep, 45.6 per cent.; of the very fat sheep, 35.8 per cent.; of the store pig, 18.8; and of the fat pig, 16.1 per cent. of its weight.

The analyses of beef and mutton do not show that there is any important difference in their composition, but there is

a prejudice in favour of beef, which is popularly believed to be the stronger food. Pork is poorer in saline matter than beef or mutton, but it is the fattest kind of animal food, and, therefore, seldom contains more than from 30 to 40 per cent. of water. Bacon contains less water than is found in pork. Irish and English bacon are very superior to American bacon, not merely in flavour, but in nutritive properties. In the former the fatty matter is more solid, and there is much less loss sustained in cooking it. The flesh of the deer is much leaner than that of the ox or sheep, and it contains much more blood: on the whole, it is somewhat inferior in alimental value, so far, at least, as fat is concerned; it is, however, very digestible. The custom of eating this kind of food in a state of semi-putridity is one which is not to be commended. The flesh of poultry and rabbits is inferior in nutritive power to that of the ox or the sheep, being very poor in fat, and containing a large amount of water. The fat of the flesh of fowl is much less digestible than beef or mutton fat. The flesh of the hare is more nutritive than that of the rabbit. The flesh of very young animals is less digestible and less nutritious than that of matured animals of the same kind. A variety of veal termed "slink" is chiefly used by the poor, but it is not fit for human food, as it is liable to produce diarrhœa. I have analysed the flesh of a calf one day old, and obtained the following centesimal results:—

Water	72.35
Fatty matters	6.07
Lean flesh and extractive matters ...	18.46
Saline matter	3.12
	100.00

Salted and "jerked" beef from South America is used *occasionally in* these countries, chiefly amongst the poorest

classes of society. I found that the analyses of three specimens of this food afforded the following average results :—

Monto Vidéo beef (100 parts contain) :—

Water	40
Fatty matters	21
Lean flesh	27
Mineral matters (chiefly common salt) ...	12
	100

The meat hitherto imported from South America and Australia has been more or less deficient in flavour, but probably the earnest efforts now being made to procure animal food from those distant regions may prove more successful in providing us with a cheap, nutritious, and well-flavoured article. Live oxen have recently been imported from South America, and have been sold at a good profit.

Fish is very poor in fibrin, but it contains a rather large proportion of albumin. In nutritive power it is very inferior to the flesh of warm blooded animals. Some fishes contain large proportions of fat, others but a small amount of that ingredient. The oily fishes, such as the salmon and the eel, are the most *satisfying* item and the least digestible in a fish diet. Fish out of season—that is, out of condition—is often a dangerous kind of food. Fishes are in their prime at the time of the ripening of the milt or roe.

Many people eat with impunity venison when it is half raw and half putrid; the same feat cannot, without danger, be performed with fish, which should only be eaten when it is quite fresh (or had been salted when fresh), and thoroughly cooked.

Shell fishes are much less nutritious than white fish. They contain from 12 to 16 per cent. of solid matter, which resembles in composition white fish. They are all rather indigestible, but oysters are the least so.

According to Chevreul, the composition of the oyster is as follows:—

Water	80.385
Nitrogenous matters	14.010
Fatty substances	1.515
Saline matter	2.695
Non-nitrogenous matters	1.395
	100.000

The so-called juice of the oyster is believed by many persons to possess valuable hygienic properties. According to Chevreul, it contains per cent. the following:—Water, 95.880; nitrogenous matters, 0.570; non-nitrogenous matters, 0.528; saline substances, 3.022=100.

The flesh of the turtle—which forms so prominent an item in the *cuisine* of civic magnates—is popularly supposed to be extremely greasy. On the contrary, it is very poor in fatty matters, which form, indeed, less than ½ per cent. of its solid ingredients. There are 76 per cent. of water and 14 per cent. of nitrogenous matter in the turtle. The soup made from the flesh of this reptile is less fatty and more easily digestible than the imitation of the article termed *mock turtle.*

Milk is the liquid designed by nature for the nourishment of the young of the mammalia. It varies in composition, digestibility, and flavour, according to the nature of the animal that yields it. When examined through the microscope, milk is seen to consist of a colourless fluid, containing numerous little vesicles, or globules filled with butter—a mixture of oily and fatty matters. When the milk is allowed to stand for some time, the globules being lighter than the clear liquid, gradually ascend to the top, and, mixed with a portion of milk, is skimmed off, and termed *cream.* A nitrogenous matter called *casein* is dissolved in the clear liquid; but after some time the latter becomes sour and causes the separation of the casein in the form of *curd.* By boiling *milk the casein,* or, at least, the greater portion of it, may

be at once coagulated, or converted into curd. Muriatic acid, rennet, and various other bodies, when added in small quantity to milk, cause a coagulum, or clot of casein to be formed.

Composition of the Milk of different Animals.

1,000 parts contain—

	Water.	Butter.	Cheesy Matter.	Sugar.	Mineral Matter.
Woman ...	889.08	26.66	39.24	43.64	1.38
Cow ...	864.20	31.30	48.80	47.70	6.00
Goat ...	844.90	56.87	35.14	36.91	6.18
Ewe ...	832.32	51.31	69.78	39.43	7.16
Mare ...	904.30	24.36	33.35	32.76	5.23
Ass ...	890.12	18.53	35.65	50.46	5.24
Sow ...	818.00	60.00	53.00	60.70	8.30

Proportions of Solids and Water in different kinds of Milk.

	Woman.	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water	889.08	864.20	844.90	832.32	904.30	890.12	818.00
Solids	110.92	135.80	155.10	167.68	95.70	109.88	182.00
	1000.00	1000.000	1000.00	1000.00	1000.00	1000.00	1000.00

The sugar found in milk does not undergo alcoholic fermentation like ordinary sugar. Were the case different, the tender stomachs of infants would often be distended and pained by the evolution of carbonic acid gas during the digestion of the milk which sometimes forms their sole food. Good cream contains about 35 per cent. of solid matter, of which about two-thirds consist of butter. Skim-milk contains about half the amount of butter found in new milk, but in other respects it is nearly equal to the former. Whey contains all the sugar and saline matter, but very little of the other ingredients of the milk from which it is produced. There is very little nourishment in it. Buttermilk is new milk *minus* the fat.

Butter consists of fatty and oily substances, casein, saline matter, and water. The fats vary from 70 to 95 per cent., the casein or cheesy matter from 3 to 8 per cent., the saline substances from a trace to 30 per cent., and the water from 10 to 35 per cent. Good mild-cured butter contains 82 per

cent. of butter, 3 per cent. of casein, 2 per cent. of salt, and 13 per cent. of water. In some very good specimens of Irish butter I found the casein to form so small a proportion as 1 per cent. The greater the proportion of casein, the less likely is the butter to keep sweet for any length of time. Casein, like most soft nitrogenous bodies, soon ferments and causes such substances as fat and starch—which alone are not liable to change—to enter also into a state of fermentation. The rancidity of butter is caused by alterations in its fatty ingredients, brought about by contact with the decomposing casein. Butter is a most valuable article of food, but as it contributes only to the nutrition of the adipose, or fatty tissue of the body, it is only a partial aliment.

Cheese is essentially composed of the casein of milk, coagulated by the addition to that fluid of rennet or an acid. Its composition is very variable. The richest kinds, such as double Gloucester and Stilton, contain more butter than casein, in *Cheddar* the butter and casein are about equal in amount, whilst in Dutch and other poor kinds of cheese made from skim-milk the casein constitutes from 80 to 90 per cent. of the weight of the solid matters. The richer kinds of cheese are the most nutritious; but on the whole this article is not, at its present price, an economical food.

Eggs are valuable and by no means dear food. That of the common fowl weighs on the average a few grains less than 2 ounces. Ten per cent. of its weight consists of shell, 20 per cent. of *white*, and 70 of *yolk*. The white consists almost wholly of albumin. The yolk contains the fatty matters, which constitute about 12 per cent. of the weight of the egg. This food is very rich in nitrogenous matters; hence it should be combined with food containing abundance of fats or starch. There is no important difference in the composition of the eggs of the various domesticated birds which are used as food.

Extract of meat (Liebig's *extractum carnis*) is rapidly coming into general use as a convenient article for the preparation of soups. It is prepared by carefully evaporating the watery extract of raw flesh to a paste. It contains no fat, fibrin, or gelatin, and but very little, if any, albumin. It is very rich in creatin, creatinin, inosinic and lactic acids, and the saline ingredients of flesh. It is believed that its action upon the animal economy merely resembles that produced by tea, coffee, and alcohol; so that it cannot be considered equivalent to the quantity of flesh from which it is obtained. A good extract of flesh contains from 50 to 60 per cent. of solid matter. Much of this article met with in commerce is very inferior; but some samples which have come under my notice had an agreeable meat-like odour. The "Liebig Company's" Extract is a very good preparation; as is also that known as Tooth's Extract, imported by Messrs. Coleman & Co. Meat biscuits and lozenges, and similar preparations, are compounds of flesh extracts with flour, &c.

The detailed composition of the more important animal foods is shown in the table at page 57.

CHAPTER V.

MINERAL FOOD.

The food of animals consists chiefly of substances derived directly or indirectly from plants, and which are termed *organic* or *organized*. Mineral substances, although they may contain all the elements which form our bodies, cannot, as a general rule, minister to our nutrition. Our bones contain large quantitites of phosphate of lime (calcic phosphate); but we cannot obtain from the mineral phosphate of lime materials wherewith to nourish our bones. Animals

contain chalk, but they dot not eat lumps of chalk. The mineral substances necessary for the sustenance of our bodies form integral and apparently essential portions of our vegetable food. The only minerals for which animals have an instinctive longing or appetite are water and common salt, which do not always exist in vegetable foods in sufficient quantities to supply the wants of animals. Soda water, Vichy water, and similar liquids, are solutions of minerals; but their use is confined to man, and they may be regarded rather as medicines than food. Iron is an indispensable part of our bodies, and is supplied in our food; but sometimes we employ this metal in a mineral form as a remedy for certain diseases, in which, as is supposed, the iron of the blood is deficient in quantity. When children suffer from the disease term *rachitis* or "rickets," it is believed that there is a deficiency of lime and phosphoric acid in their bones; hence the appropriate remedy is a mineral containing phosphoric acid and lime.

In a state of health animals exhibit no fondness for mineral foods, with the exception, as we have stated, of salt and water. Salt is a compound of the non-metallic element termed *chlorine* (well known for its bleaching and sanitary properties) and a very light metal called *sodium*. Chlorine and another light metal, termed potassium, form in combination the salt named *chloride of potassium*. Now, both chloride of sodium and chloride of potassium are essential to animal life; yet no animal would willingly partake of the latter; whilst every living creature, if deprived of common salt in its food, would greedily devour that mineral in its pure state. The reason why animals have a natural fondness for salt, and not for chloride of potassium, admits of the following explanation:—Chloride of potassium and other salts of potassium are certain to be found abundantly in every plant: no *vegetables, except*, perhaps, those of the very lowest order,

could be developed without these salts. On the other hand, sodium does not appear to be essential to vegetable life, and it is often wholly wanting in the seeds and roots, which form the most important kinds of vegetable food. We find, then, that nature has endowed animals with an appetite for mineral sodium, because that substance is not always obtainable through the agency of plants.

Salt and other saline matters are useful in causing the conversion of food into animal tissue. Dissolved in water, they constitute solutions which pass readily through the structures of the body, carrying with them the nutrient materials wherewith the waste of the body is repaired. There is very little salt in the solid tissues; but it forms nearly one-half of the weight of the saline matters of the blood. An adult requires daily from a quarter to half an ounce of salt. In barbarous ages it is said that persons were put to a painful death by confining them to a diet from which salt was excluded. In certain parts of the world where the ordinary food used contains no salt that article acquires a high value. In parts of Africa a man will sell his child, even his wife, to procure supplies of this much-coveted article.

Water forms a large proportion of our solid food; but we use it also in a liquid state, either by itself, or as an ingredient of various beverages.

Perfectly pure water is colourless, odourless, and transparent. It possesses neither flavour nor odour. Absolutely pure water never occurs naturally; and it is very difficult to produce it even by artificial means. Indeed, even in the scientific chemist's laboratory it is seldom that distilled water can be obtained free from traces of organic matter, and it is never free from one or two per cent. (by volume) of dissolved gases. For domestic purposes, absolutely pure water is not necessary, and as an article of drink it would be altogether unsuited, being insipid, and probably indigestible. But

whilst the presence of a little saline and some gaseous matters is indispensable, an excessive amount of the former and peculiar kinds of the latter render water more or less unwholesome. As for the organic matter in water, from which, as I have stated, even distilled water is never free, its presence is often most undesirable, and is never of the least advantage.

The purest natural water is rain water, though even this kind is often largely contaminated with dangerous organic matters. When collected after several wet days, it is generally almost as pure as distilled water of average quality; but the first showers that descend after a season of drought always yield a water containing nitric acid, ammonia, and, in general, salt, and organic matters of various kinds. Cisterns and barrels containing rain or other water should be carefully covered, otherwise objectionable matters are certain to get into them.

The water of large lakes is in general very soft, the amount of mineral matters being small; next in the order of softness come river waters; and lastly, those derived from springs and pumps. Of course, some well waters are very soft and river waters very hard; but, as a general rule, the three kinds of waters above named stand in the order in which I have placed them.

The mineral constituents of a well water may be present in such quantities, or they may be of such a nature, as to impart medicinal qualities to the fluid. Of these *mineral waters* I do not intend to speak, further than to express my regret that so many of our countrymen and women go to distant lands to drink, or bathe in, mineral waters in no respect superior to those furnished by the springs of Ireland—those of Lisdoonvarna, county of Clare, for example.

The ingredients of ordinary water may be arranged under three heads:—first, gaseous; second, mineral solids; third, *organic matters.* The gaseous matters in water are oxygen,

nitrogen, and carbonic acid, and, in impure waters, sulphuretted hydrogen and carburetted hydrogen. The amount of oxygen varies from 1 to 5 or 6 cubic inches per gallon. Its proportion depends on various causes: for example, aquatic plants absorb carbonic acid, decompose it, and, retaining the carbon, exhale the other constituent, oxygen. In some river and lake water so much oxygen is produced in this way that bubbles of the gas may be seen ascending through the water, and bursting upon its surface. Where much decomposable organic matter exists in water, the oxygen is not abundant, and hence its scarcity is generally an indication of the impurity of the liquid. The proportion of nitrogen in water is, in general, about double that of oxygen; whilst in the atmosphere nitrogen is four times more abundant than oxygen. One hundred volumes of water dissolve nearly 4 volumes of oxygen, whilst but 2 volumes of nitrogen are the maximum quantity dissolvable in the same amount of water. Were nitrogen as soluble in water as the vital gas, oxygen, fishes could not exist in their limpid element.

Carbonic acid is the most abundant of the gases held in solution by water. Spring waters are the richest in this ingredient, some of them, especially in the limestone and chalk formations, containing from 15 to 20 cubic inches per gallon of this gas. Waters in the granite and other primary rocks contain but little of this gas, and hence they have rather a flat flavour. On the other hand, very impure, hard waters very generally possess a pleasant flavour, owing to the large quantities of carbonic acid which they contain. It is the escape of this gas which causes the effervescence when bottles of champagne and other "sparkling" wines, beer, and aerated waters are uncorked.

As the flavour of a water depends to a great extent upon the quantity of gaseous matter contained in it, distilled water or water that has recently been boiled is anything but a

pleasant drink. Sometimes, however, it is necessary to boil water in order to destroy dangerous organic matters, when it is likely to contain such. On cooling, the water is very flat; but much of its original flavour may be restored to it by pouring it from one vessel into another and back again, repeating the operation for twenty or thirty times, and allowing the liquid to fall through a distance of two or three feet. There are about 4 parts of carbonic acid in every 10,000 parts of atmospheric air, and from this source the water absorbs the gas whilst being poured from vessel into vessel. At sea, where distilled water is often used as a drink on board steamers, it is aerated by means of atmospheric air forced into it according to a plan devised by the late Dr. Normandy.

Sulphuretted hydrogen gas possesses a most offensive odour. It is produced in large quantity by the decay of eggs, and it is noticeable wherever animals and vegetables and most of their structures are undergoing the process of decomposition. It is often found in stagnant waters, in which it may easily be recognised by the sense of smell. If this gas be abundant in water, the latter will cause a clear solution of sugar of lead to become brown or black. The presence of sulphuretted hydrogen gas in water is almost always a sign that there has been sewage contamination; and I would strongly recommend every one whose pump or well affords water having the *faintest* odour of rotten eggs not to use it without previous purification. I may, however, here remark that certain medicinal waters contain sulphuretted hydrogen derived from a mineral, *not an organic*, source: but these waters occur in very few localities, and their composition is constant; whilst water containing sulphuretted hydrogen produced by decaying organic matter sometimes has hardly any odour, and at other times evolves *a strong* odour of the fetid gas.

Carburetted hydrogen is found in marshy and stagnant

water, and in ditches, bog pools, and other places where much vegetable matter is likely to accumulate in water. In ditches this gas may be noticed breaking in bubbles on the surface of the water. Farm animals are too often supplied with water containing this gas; and there is little doubt but that some of the diseases from which they suffer are caused by the bad quality of the stagnant water which they are obliged to drink.

Water possesses a high degree of solvent powers. An immense number of substances can be held in solution by this fluid. We find, therefore, that drainage water always contains in solution certain mineral and organic substances (animal and vegetable bodies) more or less in a decayed state, besides—but not invariably—minute animals and vegetables. All these substances and organisms are derived from the air and soil through which the water passes. The nature and amount of the matters dissolved in water do not always depend upon the character of the geological formation of the district through which the water flows; but in general there is a decided influence exercised by rocks and soils on the water which flows through them. There are certain rock formations from which one may be almost absolutely certain to obtain good water; whilst, on the other hand, there are soils which seldom yield pure supplies of this liquid.

The purest water is obtained from the primitive or oldest rocks—those in which there are no organic remains. In granite, gneiss, trap, porphyry, and clay slate formations the springs and rivers are, with rare exceptions, very pure, unless when tainted by oozings into them from sewers. When the rock is covered with a very scanty clothing of vegetation, and when the soil is altogether or nearly barren, or at least not cultivated, we may be almost perfectly satisfied that the water flowing through or over it will be fit for domestic purposes. Where, however, granite, gneiss, or

other rocks of that class constitute the rock formation of a very populous district—for example, the site of a town—the wells in it may be of the most dangerous character. When we take into account the geological formation of a district as influencing the quality of its drainage water, we must bear in mind that the nature of the rock is but one condition in determining the purity or the impurity of the water. The drainage water in a primary rock district may take up only harmless quantities of solid substances from the rock itself, but it may at the same time be largely tainted by the effete matters thrown out from human habitations.

The water obtained from primary rocks contains in general from two to eight grains of solid matter per imperial gallon (70,000 grains) of water. There are two distinct classes of substances dissolved in water—the one mineral and incombustible, the other organic and combustible. In waters derived from the primitive rocks the amount of organic matter varies from half a grain to 2½ grains per gallon; but being generally peaty matter, it is perfectly innocuous. The mineral ingredients of water in primary rock formations are chiefly salts of sodium and potassium; the proportions of earthy (lime and magnesia) salts are usually very small.

The water in limestone districts and chalk is generally "hard," and not well adapted for detergent purposes. It seldom contains less than 12 grains of solids per gallon; whilst it often includes from 100 to 150 grains of solids per gallon. Sometimes the waters derived from the limestone rocks admit of being softened by boiling them; that is, at a boiling temperature their earthy ingredients are thrown down from solution. On the other hand, those waters occasionally contain gypsum and other salts of lime as well as those of magnesia, which, being soluble in boiling water, are not precipitated at a high temperature. These waters *are permanently* hard. The proportion of organic matter

is not in general very great in these waters; very often it is little more than one grain per gallon. Very hard waters are not at all suitable for domestic purposes. They are the worst kind that could be used for cooking vegetables, and infusing tea and coffee. They have, even in summer, a low temperature; and containing in general large quantities of carbonic acid (the gas that causes the sparkling appearance and some other admired properties of champagne and other beverages), they are usually pleasant to the taste. Nevertheless, I know of many instances where these very hard, though well-flavoured, waters produced various diseases of the digestive organs.

Limestone waters are the most common kind met with in Ireland. They leave thick incrustations in boilers and kettles, and when very hard they should not be used, unless in combination with rain or soft water derived from lakes or rivers. In the city of Dublin there are numerous wells and pumps, the water from which contains from 25 to 200 grains of solids—chiefly lime and magnesia salts—per gallon. Hardly five per cent. of these wells and pumps afford supplies of wholesome water.

The waters from stiff clays are sometimes very impure, chiefly owing to the presence of organic and other matters held in a state of suspension. The amount of solid matter in solution is in general very small—from two to eight grains per gallon. In stiff clays very few springs exist; but they yield abundance of surface water, and consequently superficial wells may be easily made in them. The water so obtained should always be filtered, were it even only through a layer of sand.

Gravel and loose, sandy soils sometimes yield pure water, but far more frequently the reverse is the case. In towns and other populous localities the wells in gravel often contains enormous proportions of organic matter. Still worse

is the superficial well water obtained from soft sandstone rocks, and worst of all is the fluid furnished by alluvial and marshy soils. In these waters the proportion of organic matter is very often so large as to prove most injurious to the health of those who drink it. Stagnant waters are rarely free from an excess of organic matter, and they teem with low forms of animal and vegetable life. Running water is not always pure; but even when it is tainted by sewage, the impurities are very soon oxidised. As a rule, river water is greatly to be preferred to stagnant water, except in the case of large lakes. Wells, as a general rule, do not furnish as pure a fluid as that afforded by rivers, when the latter is not contaminated by town or village sewage. Very deep wells seldom contain much organic matter, and in that respect their waters are much superior to those yielded by superficial wells; the latter, however, are generally richer in dissolved gases, and hence are better flavoured.

A large quantity of salt in water indicates the probability of sewerage impurities. Waters containing rather large quantities of lime and magnesia are termed *hard*, because it is difficult to use them for washing our bodies or clothes. The reason of this is, that the fats in soap unite with the earths in the water, and form *curds*, or insoluble soaps. Soft water does not contain earthy matters, and it is the most economical to use for detergent purposes. When the hardness of water is due to the presence of gypsum or sulphate of magnesia (Epsom salts), the addition of washing soda softens it, because it throws down, or renders insoluble, the earthy salts. Water rendered hard by the presence of chalk (the most usual cause of hardness) may be softened by the addition of lime water. The chalk is held in solution by means of free carbonic acid gas; but when lime is added, the gas and the earth unite, and form more chalk, which, together *with the chalk* originally present, become insoluble or—*to*

use a chemical term—precipitated. If too much lime be added, a portion will remain in solution, and will confer upon the water an unpleasant flavour. A few experiments suffice, however, to determine the proper proportion of lime water. Lime water is prepared by stirring a few lumps of "burned" lime in a cask of water. In a few hours a clear liquid is obtained, which should be preserved, as far as practicable, from contact with the air.

Dr. Letheby considers that very soft water is not so wholesome as water containing from 20 to 30 grains of earthy salts per gallon. He thinks that the lime contained in hard water is useful in nourishing the bony tissues. It is not, however, likely that the few grains of lime contained in the water which we drink could contribute, at least in any important manner, to the nutrition of our bodies.

The presence of decided quantities of nitric acid and nitrous acid (combined with different metals), ammonia, and albuminous bodies in water indicates sewage contamination. Such water should not be drank; or, if there is no choice, it should be boiled and filtered through animal charcoal. Typhoid fever, cholera, and other diseases are often conveyed through the medium of bad water. Well water in towns is very likely to contain animal impurities. I would, therefore, strongly recommend those who drink the water dispensed from town pumps to filter it first. Hard water may be safely stored in leaden cisterns; but soft water cannot, for it dissolves lead. An alloy of 96 parts of lead and 4 of tin is not sensibly affected by soft water. By far the best chemical purifier of water is the invaluable liquid termed Condy's Solution. It is to be regretted that it is not more frequently employed to preserve the purity of water in ships.

CHAPTER VI.

STIMULANTS AND CONDIMENTS.

Tea, coffee, and cocoa form a small but highly important group of foods, which, taken as a whole, are used almost throughout the whole world. Tea and coffee contain an identical active principle, termed *thein*, or *caffein*; and *theobromin*, the active principle of cocoa, is closely related to thein.

The dried leaves of the tea plant, which constitute the "tea" of commerce, vary very much in composition.

Average centesimal composition of black tea—

Water	5·0
Thein	2·5
Casein	14·5
Gum	18·0
Sugar	3·0
Starch	trace
Tannin	26·3
Aromatic, or volatile oil	0·7
Fats	4·0
Cellulose, or fibre	21·0
Ash (mineral substances)	5·0
	100·0

Tea, if good, yields about one-third of its weight to the action of hot water. Its astringency is owing to the large quantity of tannin, or tannic acid which it contains. It is not probable that there is any nutriment in tannin, nor is it ascertained that it contributes to produce the well-known exhilarating effects of tea. It is, however, certain that it is the cause of the constipating property which tea possesses, and which is one of the very few bad qualities of that favourite stimulant. The amount of albuminous matter is considerable, but as it yields very slightly to the solvent action of

hot water, it remains in the so-called exhausted tea leaves. The Tartars make use of nearly all the nutriment contained in tea, because they reduce it to powder and exhaust it with alkaline solutions. A little washing soda added to the water in which tea is infused greatly increases the amount of extract. The *volatile oil* confers on teas their characteristic flavour and odour. Thein is a highly nitrogenous substance: to it the stimulating effects of tea are chiefly due. It is rather curious that a spoonful of fine "gunpowder" tea weighs as much as two spoonfuls of flowery Pekoe. Four spoonfuls of fine Congou, five and a-half of flowery Pekoe, or two of fine gunpowder suffice to make a pint of infusion which will contain about one-eighth of an ounce of solid matter. The softer water is, the greater is its solvent power upon tea and coffee. Water, however, of a moderate degree of hardness makes excellent tea. A pint of boiling water extracts nearly ¼ ounce from an ounce of good tea or coffee. Neither tea nor coffee should be boiled, but merely infused in boiling water, and they should be *drawn* for at least fifteen minutes. When very hard water is used for the purpose of infusing either tea or coffee, half an hour will not be too long to allow the process to go on. A few grains of soda may be added, but the slightest excess of this salt greatly injures the flavour of the infusion.

The properties of coffee are due to caffein, a volatile oil. and an astringent substance closely resembling tannic acid. The berries when roasted should have a light brown colour. Coffee is often injured by excessive roasting. Highly heated steam is now successfully used for the purpose of partially carbonizing the berries, without injuring their flavour. Coffee loses from 15 to 20 per cent. in weight and increases 30 per cent. in bulk by being roasted. Essence of coffee is prepared by mixing burnt sugar with a highly concentrated infusion of the berries. Extract of chicory is some-

times added; but this ingredient renders coffee too astringent.

According to Payen, the coffee berry has the following composition:—

Water	12.000
Woody tissue	34.000
Fixed fatty matters	10 to 13.000
Gum, sugar, and vegetable acid	15.500
Nitrogenous matter allied to legumin (vegetable casein)	13·000
Free caffein	0·800
Compound of caffein with potash ...	3·5 to 5·000
Solid fatty essence	0·002
Aromatic essential oil	0·001
Saline matters	6·697
	100.000

Cocoa contains about $1\frac{1}{4}$ per cent. of theobromin, 50 per cent. of a solid fat, or oil called cocoa butter, and from 22 to 25 per cent. of albumin, starch, gum, sugar, and fibre. Chocolate is a mixture of cocoa with sugar: vanilla and similar substances are sometimes added as flavouring adjuncts. Some preparations of cocoa are to a great extent free from the fatty ingredients of the nut. Schweitzer's *Cocoatina* is a very nice preparation of cocoa, as it is quite free from fatty matters, and is, therefore, suited for dyspeptics. The nut separated from its husk and roasted constitutes the cocoa nibs of the grocer. Prepared cocoa or chocolate containing starch or flour requires to be boiled, but the best varieties of this article contain sugar, and require but the addition of hot water to convert them into a nutritious beverage.

Many experiments have been made and much has been written relative to the actionof tea and coffee upon the animal economy. Some authorities state that they retard the waste of tissue, without diminishing the motions of the body; but that is not likely to be the case, for the work done by the body is proportionate to the quantity of tissue or food which is *decomposed* within it. Dr. E. Smith believes that tea pro-

motes the metamorphosis, or change of tissue, instead of retarding it—a view to which I subscribe. We certainly feel more disposed to activity than to quiescence after taking a cup of strong tea. It is very likely that tea and coffee cause a more perfeot digestion or assimilation of food; and in this way we may account for the fact, as alleged, that tea and coffee are partial substitutes for food. If they enable us to extract more nutriment from our food than it ordinarily yields, they certainly contribute to the nutrition of our bodies.

According to Dr. E. Smith, tea acts favourably upon the skin, causing increased perspiration, whilst coffee diminishes the perspiration and produces a constipatory effect. There is no doubt but that tea stimulates and invigorates the system; and that under its cheering influences we become more animated and inspirited. If this beverage be taken in excess the imagination is excited, the heart's action is greatly increased, there is often a painful or anxious feeling experienced, and the disposition to sleep at the proper time is greatly lessened. The best effects of tea are produced by its use in moderate quantities and of moderate strength. The practice of taking very strong tea to banish sleep is a very bad one. The best time to take tea is about from one to two hours after dinner, when it generally stimulates the flagging energies of the digestive organs. It is a grateful beverage in the morning; but it should be taken in moderation. It is not suitable at luncheon or dinner. To the aged, tea possesses many recommendations; but in childhood, neither it nor coffee is a desirable beverage. The health of very young children is often injured by the use of tea and coffee. I have noticed that persons of dark complexions are fonder of tea than those whose fair skin and hair, light eyes, and corpulent persons betray their *leuco-phlegmatic* temperament. With the latter persons, it often disagrees. Gouty

persons, with what doctors term *lithic acid diathesis*, are often benefited by weak tea used without sugar.

Alcohol is a stimulant which possesses less of the characteristics of true food than tea and coffee; for, whilst the latter really contain some matters which are capable of forming animal tissue, there is nothing in alcohol with which any part of the body could be nourished. At one time it was believed that food could be of no use to the animal economy, except for the formation of flesh and other tissues; and according to that view, it would be vain to ascribe any nutritious properties to alcohol. It is now, however, very generally believed that food may be utilized in the body without being converted into any of its structures. If this view be the true one, we can readily understand that alcohol might, by being oxidized, or burned in the blood, produce animal heat, or motive power. It has been alleged that the alcohol introduced into the body is wholly thrown off from it unchanged; but the inaccuracy of this statement has been demonstrated by the results of Thudichum's recent experiments. When taken in very moderate quantities, alcohol, I have no doubt, performs two of the functions of food—namely, the production of animal heat and of force. It is, however, by far the most costly food in common use, and, except in certain forms of disease, it is clearly a very expensive luxury. I believe that, without exception, healthy persons do not require alcohol in any form; and in the case of children, its use is seldom beneficial, and generally injurious. Small quantities of it are certainly utilized in the system; but of the amounts usually taken at and after meals, the larger proportion subserves no useful purpose, and probably passes in great part unchanged from the body. In certain diseases, where there is rapid wasting of the body, and no capability of using sufficient food to replace the worn-out tissue, alcohol is often invaluable. Under such circumstances,

it retards the wasting of tissue, because it supplies the heat and energy which otherwise would have to be supplied at the expense of portions of the body. Dr. E. Smith states that alcohol lessens the activity of the muscles which are under our control; but that it increases the action of the involuntary muscles, such as the heart and lungs. Ultimately the action of alcohol lowers the vitality of the heart and other important organs, and checks the processes of digestion. It appears strange—but it is, nevertheless, true—that almost all competent observers assert that alcohol is a bad preventive against the effect of extreme cold. The experience of Arctic explorers clearly proves that in the icy regions of the North, fatty foods, and not alcohol, must be relied upon to maintain the necessary heat of the body. It cannot be denied that most persons find in some one of the many alcoholic drinks an agreeable beverage; and if they are used in *moderation*, at suitable times, and in a pure state, they certainly contribute greatly to the pleasures of the table without injuring the health.

Alcohol appears to produce a greater intoxicating effect when taken in the form of strong spirits, and least when drank as a constituent of such wines as claret and hock. *Raw* spirits should never be taken. If we decide upon taking, say, one glass of brandy or whiskey each day, we should accustom ourselves to mix it with three glasses of water.

The percentage of alcohol in different liquids is shown in the following table:—

	Percentage of Alcohol.		Percentage of Alcohol.
Rum	60 to 75	Chablis and Sauterne	8 " 12
Whiskey	54 " 60	Rhine wines	7 " 15
Brandy (British) ...	50 " 60	Champagne	7 " 13
French brandy ...	50 " 55	Burgundy	8 " 12
Gin	48 " 58	Moselle	8 " 13
Port wine	14 " 24	Ale	6 " 9
Sherry wine	14 " 27	Cider	5 " 9
Roussillon	11 " 16	Porter	4 " 7
Claret	9 " 14	Beer	2 " 4
Hungarian wines ...	9 " 15		

In the stronger spirits there is little, save alcohol, which acts as food. They often contain a little added sugar, and always small quantities of oily substances, and æthers, which confer upon each kind its characteristic odour, and flavour. Rum is stated to be the most stimulative of the spirits, perhaps because it is the strongest. It contains a sensible proportion of the highly odorous butyric ether. Gin possesses diuretic properties in virtue of a peculiar oil (that of juniper) which it contains, and which acts upon the kidneys. French brandy is usually the kind of strong spirit used for medicinal purposes; but unless the article is unquestionably pure, good old whiskey is preferable. Fousel oil is abundant in fresh spirits prepared from corn, and is the chief cause of the unpleasant flavour and odour of new whiskey.

Wines contain, beside alcohol, variable quantities of fruit sugar, albuminous bodies, vegetable acids, and other matters. The sugar varies from a mere trace to 25 grains per ounce of 480 grains. Mazanilla and Amontillado contain only from 1 to 8 grains per ounce; Marsala and Madeira, 3 to 35 grains; Port, 15 to 35 grains; Champagne, from 10 to 40 (average about 28) grains. Sugar is added to sparkling Champagne and Moselle. In Claret, Burgundy, and Hock there is little or no sugar. According to Bence Jones, wines stand, with respect to acidity, in the following order, those most acid being placed first:—Sherry, Port, Champagne, Claret, Madeira, Burgundy, Rhine wine, Moselle. The albuminous matters in wine are unimportant. The flavour and odour are in great part due to peculiar substances termed compound æthers, of which there appear to exist a large number. The salts consist of cream of tartar, and other compounds of potassium, tartrate of lime (calcic tartrate), salt, and some other matters, making in all about 1 grain per ounce of wine. The matter obtained by evaporating an ounce of wine to dryness weighs from 15 to 50 grains.

Beer, ale, and porter contain (excluding alcohol) more nutriment than wine. Their sugar, dextrin, and albuminous matter are capable of nourishing the tissues, their alcohol produces heat and force, and their *lupilin*, or bitter principle (derived from hops) acts as a tonic and stomachic. The physiological action of these beverages strongly resembles that of alcohol. When taken in excessive quantities they are apt to produce *plethora*, or fulness of blood. Draught porter (and probably ale, too) is, especially for dyspeptics, preferable to the bottled liquid. The saccharine nature of beer renders it unsuitable to those suffering from certain gouty and bilious affections; but in the dearer kinds of bitter ale the proportion of sugar is certainly very small, and their bitter principles impart to them semi-medicinal qualities. Bass's Burton ale and Younger's Edinburgh ale are amongst the most wholesome malt liquors in general use.

Condiments consist of sugar, salt, vinegar, spices, and other substances of strong flavour, used to impart piquancy to the staple foods. They stimulate the appetite, cause an increased flow of saliva, and, in some instances, act as stomachics. Except salt and sugar, children rarely require condiments, as their appetites are naturally excellent. In middle and old age the warm condiments, such as mustard and pepper, are often found valuable aids to digestion. Vinegar dissolves albuminous substances, with the exception of casein; it, therefore, is a good addition to salads and some kinds of fishes. Used very largely, it may attack the muscular tissues, and cause a dangerous wasting of the body; but it must be admitted that many people use vinegar in rather large quantities, and yet remain fat and strong. It is an unfortunate circumstance that manufacturers are allowed by law to add 0.1 per cent. of oil of vitriol to vinegar—an unnecessary and sometimes an undesirable addition. (vitriol often contains arsenic.

CHAPTER VII.

ADULTERATION OF FOOD.

The practice of food adulteration is a serious crime, for in many instances it not only robs the purchaser of the fraudulent article of his money, but it may also injure his health and even endanger his life. The honest trader, too, has to contend with unfair competition from those who, by vending spurious articles, are able to offer them at prices lower than the current rates. The act for the prevention of food adulteration, passed in 1860, has almost proved a dead letter; but a much more stringent and practicable measure was introduced in the last session of parliament, and will probably be made a law at the next session of the legislature.

Bread is adulterated with rice, by which the loaves are made to absorb more water; with lime water to neutralize the acidity of bad flour; with alum to whiten the colour of inferior flour. If there be a decided quantity of alum present, a slice of the bread will acquire a purple colour when dipped in an infusion of logwood. Potatoes are used in making bread, but more for the purpose of hastening the process of fermentation than as an adulterant. Cheaper flours than those obtained from wheat are used, but very rarely, as adulterants. Flour is not much adulterated, and when it is, generally with nothing worse than cheap kinds of rice flour. A little alum is occasionally found in wheat flour. Gypsum, chalk, powdered flints, and white clay have been detected in both flour and bread; but very seldom in these countries. Rice flour is very commonly adulterated with a white earthy substance, termed *terra alba*. I have found so much as 35 per cent. of this matter in rice flour

sold to bakers. Rice flour adulterated in this way is, I presume and hope, chiefly used for making paste. Arrowroot, which is a costly variety of starch, is adulterated with cheaper starches obtained from potatoes and other common vegetables. Some specimens of starch, sold as pure Bermuda arrowroot, do not contain a particle of that substance.

Butter is adulterated with excessive quantities of water and salt. It is sometimes mixed with flour, lard, suet, and turnips; in cold weather, a snowball has often been found in the centre of a roll of so-called fresh butter! Persons who go from door to door offering butter for sale almost invariably vend an adulterated article. Salted butter is well washed to free it from saline matter, mixed with a little milk, and sold as fresh butter. This is known to the initiated under the name of re-made butter; and by ingenious manipulation from 20 to 35 per cent. of water is often incorporated with it. No one should purchase extremely salted butter. A dealer was convicted before the Lord Mayor of Dublin for selling butter which, as I proved, contained 33 per cent. of salt. The rich, yellow colour of butter is sometimes natural; but is often produced by the vegetable pigment, termed *annato.* Cheese is adulterated with starch or flour. A drop of tincture of iodine produces a blue stain on cheese if starch be present. Copper and even arsenic have been found several times, but evidently not as intentional adulterants. Milk, in towns, is almost invariably adulterated with, on the average, 33 per cent. of water. I have examined about 500 samples of milk in my capacity of Analyst for the City of Dublin, in not one of which did I find any adulterant save water, and, but very rarely, a little sugar and salt. I have found so much as 70 per cent. of added water in milk; 100 parts of milk, evaporated to dryness, leave at least 12 parts of solid residue. If there be only 11 parts, then the milk contains 8 per cent. of water; if 10 parts, 16

cent. of water, and so on. Lactometers are often very fallacious in their indications.

In raw sugar, little insects (*acari*) and various natural impurities are generally present; but in the refined article we very rarely find any foreign matters. Only one case of intentional adulteration (with flour) has come under my notice.

Tea is sometimes adulterated with tea leaves which have been exhausted of their soluble matter, and dried: catechu, gum, and starch are added to the exhausted leaves. Spurious tea of this kind is, of course, almost destitute of flavour. Green teas often owe their colour to "facings" of Prussian blue, turmeric, and clay. Black lead is often used to *glaze* black tea. Coffee is generally adulterated with chicory; wheat and other grains, raspings of bread, beans, burnt sugar, and various other articles, are occasionally mixed with it in proportions varying from 10 to 60 per cent. Even chicory, the adulterant, is itself sophisticated, and, as alleged, with such materials as seeds, acorns, mangel-wurtzel, and baked liver of the horse! It may be stated, with almost absolute certainty, that coffee sold at less than 1s. 8d. per lb. is adulterated. Many persons believe that chicory is a wholesome addition to coffee; but there is really no evidence to justify such an opinion. The analysis of chicory shows that it contains no active principle like caffein. The continued use of it is likely to produce dyspepsia, for the root contains an excessive proportion of astringent matter. The numerous foreign substances found in coffee are generally introduced into it through the medium of the highly adulterated chicory sold to the grocers. Cocoa and chocolate are adulterated with sugar, starch, and flour. Other forms of adulteration are rare.

Pickles when *very green* are almost certain to contain *copper, and this* metal is sometimes found, but happily in

minute quantities, in vinegar. A penknife blade left for a few hours in vinegar or any other liquid containing copper will become coated with that metal. Mustard is almost invariably adulterated with flour and even with plaster of Paris. Of several specimens which I examined some time ago, Colman's was the only kind which I found absolutely pure. Ground pepper is mixed with linseed, mustard, and rice and other grains.

Wines are adulterated with infusions of various kinds of wood and bark containing colouring and astringent principles. Lime, salts, alum, distilled spirits, and tannin are but examples of the numerous adulterants of wine. Litharge (a compound of lead) is said to be employed to correct the acidity of wine. A large proportion of the wines used in these countries is genuine, and purity is not confined to the high-priced articles. Much of the so-called adulterated wine is perfectly genuine, but of very inferior natural qualities. French brandy is readily obtained in these countries at respectable establishments, and at fair prices. Under the name of brandy, corn spirit, mixed with flavouring matters, is often sold. Whiskey is rarely adulterated with anything worse than water; but it is often sold when too fresh, and is then popularly supposed to contain bluestone or oil of vitriol. Gin is liable to be adulterated with capsicums and oil of bitter almonds; and, it is stated, with sulphuric acid. Beer, ale, and porter are in general quite pure; but the following unnecessary substances have been detected in them by various chemists:—Oil of vitriol, lime, soda, salt, alum, pepper, capsicums, grains of paradise, gentian, quassia, and chicory. It was at one time believed that strychnine was employed to impart a bitter flavour to ale, but I believe such a dangerous adulteration never existed. Inferior ales and porters are often sold as Bass' ale and Guinness' stout.

Sugar confectionary—more especially the cheaper kinds—

is sometimes adulterated with whiting, *terra alba* (a white clay), and plaster of Paris; and it is coloured with the poisonous yellow and orange chromate of lead, Prussian blue, and vermillion, instead of harmless vegetable pigments. A green compound of arsenic and copper was formerly much employed in colouring confectionery, but owing to the numerous cases of illness and death which resulted from the practice, this article is now rarely, if ever, employed. I have recently examined a large number of specimens of coloured confectionary on sale in Dublin. In most cases those coloured yellow contained chromate of lead; much more rarely the red confectionary owed its tint to vermillion (sulphide of mercury). I would recommend the use of colourless confectionary in preference to the coloured, however inviting the appearance of the latter may be.

CHAPTER VIII.

DISEASED MEAT.

THE flesh of animals affected with parasitic and other forms of disease is more or less unwholesome, and is often highly dangerous to the health, and even life, of those who eat it. The cause of many deaths has been clearly traced to the use of diseased meat; and cases of illness from this source come frequently under my observation. In Dublin, from 40,000 to 50,000 lbs. of diseased and otherwise unsound animal food are seized and confiscated monthly; but I fear that in but very few towns in the United Kingdom is there any organized system of food inspection. In London and Dublin the vendors of diseased meat are frequently punished by *imprisonment* or heavy fines.

The bodies of animals are often inhabited by minute creatures, termed *entozoa* (singular, entozöon), or internal parasites. The most formidable of these pests is probably the *Trichina spiralis*, which is found in various species of animals, but chiefly in the pig. The trichina is a kind of worm about the thirtieth of an inch in length. It is generally found coiled up in a little vessel, or cyst, which is chiefly formed of chalk. When flesh containing these cysts is eaten, the juices of the stomach dissolve the chalk, and set free its dangerous prisoner, which immediately begins to wander through the body and to multiply its species. During the passage of trichinæ through the muscles, the most excruciating pains are experienced, and death is often the result. Two cases of trichinæ in the human subject have come under my own observation in Dublin; but I have never detected these dangerous parasites in Irish pork or bacon, though I have repeatedly sought for them. Several outbreaks of *trichiniasis*—as the disease produced by this worm is termed—have occurred in Germany. In Hettstädt, a small town in Saxony, one trichiniferous pig infected 158 persons, of whom 28 died.

Measles in the pig is caused by little worms termed *Cysticerci cellulosæ*, which take up their abode in the animal's flesh, and are found chiefly in the spaces between the muscular fibres. They raise little prominences under the skin, which symptom, together with a yellow speck in the angle of the eye, and in general a peculiar thickness of the neck and thinness of the loins, easily enable the measly pig to be detected. The worms are found in all the muscles, and they are usually very numerous in the under part of the tongue. The measle worm is the immature condition of the tapeworm (*Tænium solium*), and the use of measly pork is probably a common cause of the presence of the latter parasite in the human subject. In some countries the use of mea

pork is strictly prohibited by a special law. A smaller species of measle worm is found in the flesh of the ox, and when it passes from thence into the body of man it is developed into the common species of tape-worm, termed *Tænia mediocanellata.* The "rot" in sheep and oxen is the result of the ravages of large parasites popularly called flukes, but in scientific language termed *Distomæ hepaticæ;* they reside in the liver. It is probable that they rarely find their way from the lower animals into man; at least, they are not often detected in the human liver.

The flesh of animals affected by such diseases as blackleg, infectious lung distemper, or pleuro-pneumonia, and small-pox can hardly be perfectly wholesome food; but when the disease is in an advanced stage there can be little doubt as to its dangerous properties. In pleuro-pneumonia the weight of the lungs often increases from about 10 or 12 lbs. to more than 70 lbs. weight, and they become loaded with purulent matter. Surely the flesh of animals whose lungs—the great purifying organ of the blood—are in such a state could not form wholesome food!

Cooking destroys the parasites contained in flesh, but the process must be thoroughly carried out. Underdone, or red flesh has often been found to contain living parasites. To be certain that our food is thoroughly cooked, we should see that it is served to us "smoking hot." Thorough cooking, too, in all probability renders the flesh of animals affected with such diseases as pleuro-pneumonia far less dangerous.

Game is often eaten when in a semi, or nearly semi, putrid state; but there are numerous instances on record which prove that tainted meat is liable to produce illness, and even death. Every one is aware of the poisonous qualities of stale fish. Mouldy and rancid foods, whether animal or vegetable, are very likely to produce nausea and diarrhœa. *Scores of people* have died from eating musty sausages.

The following are some of the characteristics of good meat:—Pale red colour, faint, and not disagreeable odour, firmness a few hours after death. Diseased meat remains soft, and exudes watery matter, especially from the membrane investing the fat; its odour is almost invariably unpleasant, and sometimes is actually loathsome. Its colour is at first very bright pink (from the inflammatory state of the blood diffused through it); but after a short time it becomes dark. Of course, when the blood is not removed from the carcass, the flesh from the first is purplish, very dusky, or blackish red. In very advanced stages of disease the flesh sometimes becomes neutral or alkaline soon after death. Healthy flesh is always decidedly acid.

The milk of cows suffering from foot-and-mouth disease is liable to produce ulcers in the mouths of those who make use of it. It is stated that pigs fed upon it have died in consequence of its poisonous qualities. Foot-and-mouth disease generally assumes an epidemic, or rather epizootic, form, and gradually subsides. It is not commonly present amongst our dairy herds.

CHAPTER IX.

NUTRITIVE VALUE OF FOODS.

The commercial value and the nutritive value of foods are very different things. A shilling's worth of one kind of food may contain more actual nutriment than is present in a pound's worth of another variety. High priced foods owe their value to the superiority of their flavour, and, but to a less extent, to their rarity. Amongst the ordinary foods of the people there are, however, considerable variations in their nutritive properties; and chemists and physiologists are endeavouring to determine which are the animal and vegetable substances that yield the largest amount of diges-

tible nutriment at the smallest cost. The solution of this problem is hampered with many difficulties. We may, of course, analyse the different foods, and ascertain which of them contain the greatest quantities of albuminous matters, fats, and other alimental principles; but until we know whether or not these ingredients are capable of being assimilated, the mere percentages of albuminoids and carbo-hydrates in foods do not strictly represent their actual nutrimental value. One mode of estimating the value of food consists in determining the amount of heat which it gives off when burned. Heat is the equivalent of motive power; and, therefore, the food which evolves the most heat is best capable of supplying animal heat and motive power. It must, however, be borne in mind that unless food is completely digested and utilized in the animal economy, its full thermotic, or heat-producing power will not be rendered available. Cellulose is contained in vegetable foods, but it is indigestible; therefore, although it produces a large amount of heat when burned outside of the body, it cannot be got to burn within it. Again, the albuminous constituents of food are not, under any circumstances, completely exhausted of their *force*, or latent heat and energy, in the body; for, having been thoroughly digested, and their elements in new combinations ejected from the system, these latter still are capable of being burned. Corrections can, however, be applied in the case of the albuminoids; and as our knowledge of the relative digestibility of the albuminoids, fats, and carbo-hydrates in different foods is by no means limited, we are enabled to make a tolerably accurate estimate of the absolute and relative values of foods by analysing them, and determining their heat-giving and force-producing power.

The following table, constructed by Dr. Letheby, exhibits the chemical composition of the more important foods, according to the most recent analyses :—

NUTRITIVE VALUES OF FOOD.

	WATER.	ALBUMIN, &c.	STARCH, &c.	SUGAR.	FAT.	SALTS.	TOTAL PER CENT. Nitrogenous.	TOTAL PER CENT. Carbonaceous, as Starch.	Carbonaceous to one Nitrogenous.	TOTAL PER CENT. Nitrogen.	TOTAL PER CENT. Available Carbon.
Bread	37	8.1	47.4	3.6	1.6	2.3	8.1	55.00	6.8	1.25	28.21
Wheat flour	15	10.8	66.3	4.2	2.0	1.7	10.8	75.50	7.0	1.66	38.57
Barley meal	1	6.3	69.4	4.9	2.4	2.0	6.3	80.30	12.8	0.97	36.61
Oatmeal	15	12.6	58.4	5.4	5.6	3.0	12.6	77.80	6.2	1.94	40.44
Rye meal	15	8.0	69.5	3.7	2.0	1.8	8.0	78.20	9.8	1.23	38.48
Indian meal	14	11.1	64.7	0.4	8.1	1.7	11.1	85.35	7.7	1.71	43.09
Rice	13	6.3	79.1	0.4	0.7	0.5	6.3	81.25	12.9	0.97	39.03
Peas	15	23.0	55.4	2.0	2.1	2.5	23.0	62.65	2.7	3.54	38.55
Arrowroot	18	—	82.0	—	—	—	—	82.00	—	—	36.44
Potatoes	75	2.1	18.8	3.2	0.2	0.7	2.1	22.50	10.7	0.31	10.98
Carrots	83	1.3	8.4	6.1	0.2	1.0	1.3	15.00	11.5	0.20	7.28
Parsnips	82	1.1	9.6	5.8	0.5	1.0	1.1	16.65	15.1	0.17	7.91
Turnips	91	1.2	5.1	2.1	—	0.6	1.2	7.20	6.0	0.19	3.76
Sugar	5	—	—	95.0	—	—	—	95.00	—	—	42.22
New milk	86	4.1	—	5.2	3.9	0.8	4.1	14.95	3.6	0.63	8.55
Skim milk	88	4.0	—	5.4	1.8	0.8	4.0	9.90	2.5	0.62	6.26
Buttermilk	88	4.1	—	6.4	0.7	0.8	4.1	8.15	2.0	0.63	5.53
Cheddar cheese	36	28.4	—	—	31.1	4.5	28.4	77.75	2.7	4.37	47.77
Lean beef	72	19.3	—	—	3.6	5.1	19.3	9.00	0.5	2.97	12.98
Fat beef	51	14.8	—	—	29.8	4.4	14.8	74.50	5.0	2.28	39.99
Lean mutton	72	18.3	—	—	4.9	4.8	18.3	12.25	0.7	2.82	13.95
Fat mutton	53	12.4	—	—	31.1	3.5	12.4	77.75	6.3	1.91	40.33
Veal	63	16.5	—	—	15.8	4.7	16.5	39.50	2.4	2.54	25.22
Fat pork	39	9.8	—	—	48.9	2.3	9.8	122.25	12.5	1.51	58.89
Green bacon	24	7.1	—	—	66.8	2.1	7.1	167.00	23.5	1.09	77.52
Dried bacon	15	8.8	—	—	73.3	2.9	8.8	183.25	20.8	1.36	85.53
Tripe	68	13.2	—	—	16.4	2.4	13.2	41.00	3.1	2.04	24.36
Poultry	74	21.0	—	—	3.8	1.2	21.0	9.50	0.4	3.23	13.99
White fish	78	18.1	—	—	2.9	1.0	18.1	7.25	0.4	2.79	11.64
Eels	75	9.9	—	—	13.8	1.3	9.9	34.50	3.5	1.53	19.93
Salmon	77	16.1	—	—	5.5	1.4	16.1	13.75	0.8	2.48	13.60
Entire egg	74	14.0	—	—	10.5	1.5	14.0	26.25	1.9	2.16	18.18
Butter and fats	15	—	—	—	83.0	2.0	—	207.50	—	—	92.22
Beer and porter	91	0.1	—	8.7	—	0.2	0.1	8.70	87.0	0.02	3.92

The available carbon consists of all the carbon of the carbonaceous constituents of the food, and of the carbon of the nitrogenous after deducting the carbon of the urea which is excreted, 100 of dry nitrogenous matter yielding 31.23 urea.

The amount of heat that raises the temperature of one pound of water 10° Fah. is equivalent to the mechanical power, or force that raises 772 lbs. one foot high, or one pound through a height of 772 feet. Frankland has determined the amount of force which different foods evolve when burned, and (by calculation) that produced when they are completely utilised in the body. Some of the more important of these results are given in the following table :—

Mechanical power obtained by burning 10 grains of different kinds of food in oxygen, and by their oxidation in the body.

Name of Food.	Per cent. of Water in Material.	Lbs. Lifted 1 foot high. When Burnt in Oxygen.	Lbs. Lifted 1 foot high. When Oxidised in the Body.
Butter	15	14,421	14,421
Cheshire cheese ...	24	9225	8649
Oatmeal ...	15	7952	7800
Wheat flour ...	15	7813	7623
Pea-meal ...	15	7813	7487
Arrow-root ...	18	7766	7766
Ground rice ...	13	7566	7454
Yolk of egg ...	47	6809	6559
Lump sugar ...	19	6649	6649
Grape sugar ...	20	6510	6510
Entire egg (boiled) ...	62	4732	4526
Bread crumb ...	44	4431	4263
Ham (boiled) ...	54	3929	3321
Mackerel ...	71	3551	3200
Lean beef ...	71	3111	2829
Lean veal ...	71	2609	2324
Guinness's stout ...	88	2138	2138
Potatoes ...	73	2007	1977
Whiting ...	80	1791	1569
Bass's ale ...	88	1536	1536
White of egg ...	86	1328	1143
Milk ...	87	1312	1246
Carrots ...	86	1050	1031
Cabbage ...	89	864	834

To raise 1,000,000 lbs. a foot high is an extremely hard day's work for a strong man; yet the force necessary for the accomplishment of this labour is stored up in 700 grains, or somewhat less than 1½ ounces of butter. Heat and motive power are wasted when applied by means of mechanical contrivances. Not a tenth part of the heat generated beneath the boiler of a locomotive is converted into available mechanical energy. The animal mechanism contrived by divine wisdom is that in which heat and force are most completely economised, yet even in it there is some waste of energy, and especially of the materials from which it is evolved. It is found that practically food yields only about one-half of the force which, according to theory, it actually contains. The internal movements of the body—such as respiration and the heart's action—are sustained by the combustion of food (or of the blood and tissues into which it is converted), and in the case of an adult man are daily maintained by a force competent to raise about 600,000 lbs. a foot high. A man whose daily work is equivalent to the raising of 400,000 lbs. a foot high will therefore use 6-10ths of the force evolved by his food in merely sustaining the vital functions of his body. The amount of energy necessary to sustain a man for 24 hours is equal to the force set free by the combustion of each of the following quantities of food:—

Food.	Ounces.
Cabbage	31·0
Carrots	25·6
Milk	21·2
Potatoes	13.4
Lean veal	11·4
Lean beef	9·3
Lean ham	7·9
Lump sugar	3·9
Flour	3·5
Pea meal	3·5
Oatmeal	3·4
Butter	1·8

Liebig, many years ago, divided foods into two great classes—the nitrogenous, or flesh-forming principles, and the non-nitrogenous, or fat-forming and heat-giving principles. The nitrogenous matters repair the muscles, which undergoing incessant changes are the source of animal motive power, or energy. The non-nitrogenous serve to form fat, which, when oxidized, or slowly burned, produces the heat which maintains the temperature of the body. The results of the experiments of Voit, Mayer, Fick, Wislicenus, E. Smith, Parkes, Frankland, Haughton, and others, lead to the conclusion that the non-nitrogenous portion of our food is the chief source of muscular force. It would appear that during activity the muscles grow rather than waste, but after exertion there is a slightly increased excretion of nitrogen from them. As the great bulk of our food is made up of non-nitrogenous matter, which is also in general the most digestible, it is evident that upon it chiefly depends the production of both heat and energy within our bodies. Whether or not the food must be converted into blood, muscle, or fat before it is available for the production of heat and energy is still a vexed question. It is most probable that the food is converted into blood, or in some way intimately incorporated with that fluid; otherwise it is difficult to conceive how the force it contains could be applied to the purposes of the body.

CHAPTER X.

DIETARIES.

Every part of the body undergoes decay, more or less rapid, and its elements in new combinations are eliminated almos wholly in the forms of water, carbonic acid gas, and a highly nitrogenous solid, termed *urea.* The matter that leaves the body is termed *ejesta:* the matter that enters the body, in order to replace that which leaves it in the form of ejesta, is called *injesta*, or, in common language, food. The ingesta is highly organized, and contains, as I have already explained, a large amount of latent, or hidden force; but the ejesta is so nearly in a mineral, or inorganic form, that it contains almost no latent force. If the injesta exceeds the quantity necessary to take the place of the ejesta, the excess either increases the weight of the body, or it is ejected in a condition in which it still retains its heat and force-producing properties. The great majority of the people of the upper and middle classes introduce more food into their bodies than is necessary for the purpose of nutrition; and they are, consequently, the greatest sufferers from dyspepsia, obesity, plethora, and similar diseases arising out of over-nutrition. On the other hand, a large proportion of the population subsist on a diet which barely serves to sustain the motions of their bodies. Lastly, there is a small proportion of the population who do not receive sufficient food wherewith adequately to repair the inevitable waste of their bodies. These unfortunates exist in every stage of starvation. Some are actually dying rapidly for want of food; others are perishing slowly, but surely, from insufficient aliment; many barely succeed in keeping their miserable and wasted bodies alive. The greatest sufferers from defective nutrition are young children, of whom many thousands

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annually perish in the United Kingdom for want of proper nourishment.

According to the researches of E. Smith, an adult man cannot exist unless supplied daily with food containing 4,100 grains of carbon and 190 grains of nitrogen. Two pounds of bread furnish this amount of carbon; but it requires 2¼ lbs. of bread to provide the nitrogen. 2¼ lbs. of bread per day constitute a famine diet for a man, and 1¾ lbs. of bread a famine diet for a woman.

From a careful study of the researches of Voit, Pettenkofer, E. Smith, and other investigators, I have come to the conclusion that an adult requires daily per 100 lbs. of his weight the following *minimum* quantities of food principles:—

	Ounces.
Nitrogenous substances	1½
Fats	¼
Starch, or other carbo-hydrate	9
Saline matter	½
	11¼

According to Moleschott, a working man of average height and weight requires daily—

	Ounces, Avoirdupois.
Albuminous, or flesh-forming substances ...	4.587
Fatty bodies	2.964
Carbo-hydrates (starch, sugar, &c.) ...	14.267
Salts	1.048
	22.866
Water	98.580
	121.446

According to Lyon Playfair, 3 oz. of flesh-formers, ½ oz. of fat, and 12 ozs. of carbo-hydrates are the minimum quantities on which an adult can exist.

The following table shows the dietaries of work people *poorly or barely* fed, according to E. Smith's calculations:—

WEEKLY DIETARIES OF LOW-FED OPERATIVES, CALCULATED AS ADULTS (DR. E. SMITH).

Class of Labourer.	Bread Stuffs.	Potatoes.	Sugars.	Fats.	Meat.	Milk.	Cheese.	Tea.	Containing Carbon.	Containing Nitrogen	Cost.
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Grains.	Grs.	s. d.
Needle women (London) ...	124.0	40.0	7.3	4.5	16.3	7.0	0.5	1.3	22,900	950	2 7
Silk weavers (Coventry) ...	166.5	33 7	8.5	3.6	5.3	11 6	1.0	0 3	27,028	1104	1 11¾
Silk weavers (London)	158.4	43.8	8.8	5.5	11.9	4.3	0 3	0.6	48,288	1165	2 8¾
Silk weavers (Macclesfield) ...	138.8	26.6	6.3	3.4	3.2	41.9	0.9	0.3	27,346	1177	1 8½
Kid glovers (Yeovil)	140.0	84.0	4.3	7.1	18.3	18.3	10.0	0 9	28 623	1213	2 9½
Cotton spinners (Lancashire) ...	161.8	22.6	14.0	3.1	5.0	11.8	0.7	0.7	29,214	1295	2 3
Hose weavers (Derbyshire) ...	190 4	64.0	11.0	3.9	11.9	25.0	2.2	0 4	33,537	1316	2 6¼
Shoemakers (Coventry)... ...	179.8	56 0	10.0	5.8	15.8	18.0	3.3	0.8	31,700	1332	2 7¾
Farm labourer (England) ...	196.0	96.0	7.4	5.5	16.0	32.0	5.5	0.5	40,673	1594	3 0
Farm labourer (Wales)	224.0	138.7	7.5	5.9	10.0	85.0	9 8	0.5	48,354	2031	3 5½
Farm labourer (Scotland) ...	204.0	204.0	5.8	4.0	10.3	124.8	2.5	0.7	48,980	2348	3 3¾
Farm labourer (Ireland) ...	326.4	92.0	4.8	1.3	4.5	135.0	—	0.3	43,366	2434	1 9¾
Mean of all	184.2	78.1	8.0	4.5	10 7	42.9	3.1	0.6	34.167	1500	2 7¾
Average per day	26.3	11.1	1.4	0.6	1.5	6.1	0.4	0.1	4.881	214	0 4½

Pettenkofer and Voit state that a proper dietary for soldiers should include 5.2 ounces of dry albuminous substances, 3.63 ounces of fat, and 13.3 of carbo-hydrates. According to Playfair, the diet of British soldiers contains—Flesh-formers, 4.230 ozs.; fat, 1.665 ozs.; carbo-hydrates, 18.541 ozs.; mineral matter, .789. Total, 25.245.

According to Dr. Parkes, the French soldier receives 4.31 ounces of flesh-formers, 1.328 of fat, and 18.212 of starch, sugar, and other carbo-hydrates.

The diet of the British soldier on home service consists of:—Meat, 12 ozs.; bread, 24 ozs.; potatoes, 16 ozs.; other vegetables, 8 ozs.; coffee, .33 ozs.; tea, .16 ozs.; sugar, 1.33 ozs.; milk, 3.25 ozs.; salt, .25 ozs.: total, 65.32 ounces; costing, according to the state of the markets, from 7d. to 9d. Military prisoners at hard labour receive from 8 to 10 ozs. of oatmeal, 9 to 12 ozs. of Indian meal, 8 ozs. of bread, and 24 ozs. of milk.

The following is an approximation to the composition of the body of an average man:—

Centesimal Composition of Man.

Water	72.00
Fat	9.25
Gelatin	10.00
Albumin	3.00
Fibrin, &c.	3.00
Earthy and alkaline salts and a little iron	2.75
	100.00

It has often been said of the Irish small farmers and agricultural labourers that their food is relatively deficient in nitrogenous matters; but Dr. Smith shows that it contains 25 per cent. more nitrogen than is supplied by the diet of the English agricultural labourer. Dr. Smith also states that the Irish eat less potato than the English, and not half the amount consumed by the Scotch. Dr. Smith's statistics

were collected since the potato famine, and at a time when Indian meal and oatmeal were largely used in Ireland; but during late years the potato is rapidly supplanting the Indian meal and oatmeal, and, therefore, new statistics relative to the food of the Irish peasantry are required. When the Irish small farmer subsisted upon an exclusively potato and buttermilk diet, he consumed (as I find by careful inquiries) 14 lbs. of potatoes and 3 (16 ounces) pints of buttermilk per day. This would give him—allowing 24 oz. for waste, skins, &c.—200 oz. of potatoes and 48 oz. of buttermilk per diem, or at the weekly rate of 42 oz. of albuminates, 210 oz. of starch, 56 oz. of sugar, and 3½ oz. of fat. These figures show that in albuminates and carbo-hydrates the diet of the Irish peasant was superior to that of the agricultural labourers of England and Scotland, and even to that of soldiers and sailors. They also show there was a proper proportion between the albuminates and carbo-hydrates. The striking defect of the diet was its very small amount of fat; its great bulk, too, was not a recommendation. This diet is still in use, but rarely; oatmeal, Indian meal, and flour being very generally employed throughout the country.

The dietaries of well-fed operatives, calculated by Lyon Playfair, are shown in the following table:—

Quantities of Food Consumed Weekly by Operatives.

	Albuminous Matters. Ounces.	Fats. Ounces.	Starch and Sugar. Ounces.	Carbon. Grains.	Nitrogen. Grains.
Fully-fed tailors ...	32.97	9.57	129.29	35 952	2.275
English sailor ...	35.00	17.99	100.73	23.838	1.764
French sailor ...	40.18	9.24	166.20	44.653	2.835
English navvy ...	60.18	26.74	194.67	58.065	3.374
Blacksmith ...	44.40	17.50	186.50	48.048	3.059

The tables of analyses, &c., contained in this and the preceding chapters, and the information in relation to food given generally in the preceding pages, will enable the

ligent reader to construct dietaries adapted to the wants of different classes of persons. Women require about 10 per cent. less food than men of the same weight; but as the bodies of children are growing, they require more food in relation to their weight and labour than adults. In calculations, $2\frac{1}{2}$ lbs. of carbo-hydrates (sugar, starch, &c.) are only equal to 1 part of fat. Due allowance must be made for the cellulose, and other well-known indigestible substances, present in some foods.

CHAPTER XI.

COOKING FOOD.

Food is submitted to various processes, termed collectively *cookery*, for the purpose of rendering it more pleasing to the eye, more agreeable to the palate, and more yielding to the digestive action of the stomach. There is not only great art, but even science in cookery; and there is no doubt but that much valuable nutriment is wasted, owing to the bad methods of preparing food which are prevalent in so many households.

There is greater simplicity in the cookery of these countries than in the *cuisine* of our French and some other continental neighbours. The true Briton still loves the *blood red* joint which found such favour in the eyes, or rather mouth, of his medieval ancestor; whilst the Frenchman's meat is so thoroughly cooked and seasoned that it is almost im*possible to know* the nature of the animal that furnished it.

On the whole, I think the English do not sufficiently cook their joints; whilst, perhaps, the French go a little too far towards the other extreme. Of late years the cookery systems of the two countries have been somewhat reacting upon each other—no doubt, to their mutual advantage. In the matter of economy, the *cuisine* of the middle and lower classes in France is decidedly superior to the methods of cooking adopted by the corresponding classes of society in Great Britain. The French buy their meat every day, and serve it up in the form of soups, ragouts, and various highly seasoned dishes. In this way they can indulge in hot dinners every day. On the other hand, the British well-paid artizan, clerk, and even professional man, is obliged to dine too frequently on cold meat, because the purveyor of his household adheres to the national custom of purchasing joints or other large pieces of meat. There is occasionally waste, too, incurred by buying large joints; for although the dreaded "cold shoulder" of mutton may be cheerfully endured the day after it had been discussed hot and juicy, still few—not even the most economical *pater familiæ*—would like a third visitation from the same joint. If the French system were suddenly to supplant the time-honoured cooking institutions of these countries, I fear that the cooks would be serious sufferers; for in France their fatty perquisites are very small indeed. The French are just as particular in dressing their vegetables as in preparing their meat; and they have very ingenious and economical methods of incorporating both classes of food into composite dishes of excellent flavour. In Ireland meat is not quite so generally made use of in the very underdone condition in which it is served up in England. The Scotch, too, appear to cook their meat more thoroughly, and they somewhat resemble the French in the variety of their "made" dishes. In Paris the ver meat is sold in very small quantities, but in the large

of the United Kingdom it is difficult to purchase beef or mutton of the best quality unless in large quantities.

The most economical way to use meat is to cook it in hot water, and eat it served up in its own gravy. If meat be boiled for the purpose of forming soup, the water should not be abruptly raised to the boiling point; for, otherwise the albuminous matters speedily coagulate, and prevent the juices of the meat from passing into the water. The meat should be chopped or cut as fine as possible, steeped for some time in cold water, and then the latter may be gradually heated up to a temperature not exceeding 150 degs. Fahrenheit, or 62 degs. lower than the boiling point of water. At the last moment the temperature of the soup may be allowed to reach the boiling point. Bones require to be boiled, or rather *simmered*, for eight or ten hours, in order fully to extract their nutritive matter. They should be thoroughly crushed. When the meat is to be used with the soup formed from it, the boiling need not be so prolonged as to render the flesh insipid.

Soup contains the greater part of the saline matter, the crystalline principles (*creatin*, *creatinin*, &c.), some of the albumin and fat, and an amount of gelatin, dependant upon the duration of the boiling process. Nearly all the odorous matters contained in the meat are transferred to the soup. Cold water extracts from one-sixth to one-fourth of the weight of the solid ingredients of meat; and in this watery extract the savoury, saline, and crystalline ingredients are very abundant. After long continued boiling, meat becomes a hard mass, composed of horn-like, muscular fibres, the (*areolar*) tissue connecting them, and parts of the nerves and blood vessels. It is almost impossible to masticate it: it is nearly perfectly indigestible; and it is so devoid of flavour that it is impossible to know from its properties the nature

of the animal that furnished it. Even a dog, as Liebig says, will reject it.

E. Smith, in his excellent work on Practical Dietaries, gives several good receipts for soup for the working classes, of which the following are two examples:—*Soup for* 100 *persons.*—"Meat liquor from 7 lbs. of beef and 1 lb. of bones; split peas, 13 lbs.; carrots and swede turnips (of each), $6\frac{2}{3}$ lbs.; onions, $5\frac{1}{2}$ lbs.; leeks, $\frac{1}{2}$ lb.; salt, pepper, and herbs." These materials would require 12 gallons of water. *Broth for* 100 *persons.*—"Meat liquor from 7 lbs. of beef and 1 lb. of well broken bones; split peas ($1\frac{1}{3}$d. per lb.), $2\frac{3}{4}$ lbs.; Scotch barley ($1\frac{1}{3}$d. per lb.), 3 1-5th lbs.; carrots ($\frac{1}{4}$d. per lb.), $3\frac{1}{2}$ lbs.; turnips ($\frac{1}{8}$d. per lb.), $3\frac{1}{2}$ lbs.; cabbage and other green vegetables, $7\frac{1}{4}$ lbs.; salt, pepper, and dried herbs."

For invalids beef soup is by far the best. That made from mutton is less digestible, and is seldom free from fatty matter. Veal (which forms the "stock" of white soups) does not form a good soup for the sick. The presence of a large quantity of highly nitrogenous crystalline principles in soup accounts for its wonderful restorative powers. Very strong beef tea might almost be classed with such stimulants as brandy and tea. Creatin, creatinin, and other similar bodies in meat bear a close resemblance to the thein of tea and coffee and the theobromin of cocoa. The best form in which animal food can be given to children is, perhaps, as beef soup, or tea.

If we wish to cook meat in such a way as to preserve, as much as possible, its nutritious properties and its digestibility, we should proceed as follows:—The meat is placed in one or more *large* pieces in boiling water, and kept there for five minutes. The high heat coagulates, or clots the albumin at the surface of the meat, stops up its pores, so to speak, and thereby prevents, to a great extent, the juices of the meat

from leaving it. The boiling is continued for about five minutes, and then cold water is added, so as to reduce the temperature to about 150 degs. Fah.; and the cooking process goes on at that degree of heat until the meat is done. Meat that is cooked altogether at the boiling point is generally tough. By boiling, meat loses from 20 to 35 per cent. of its weight; the average for beef being about 25 per cent., and for mutton a little more. Salted meat intended to be eaten cold should be allowed to cool in the water in which it has been boiled.

In roasting meat the object should be to apply the heat so suddenly as to immediately coagulate the albumin at the surface, just as I have described should be done in boiling meat. The meat is at first placed close to the fire, kept there for about 10 or 15 minutes, and then withdrawn to a greater distance from the heat. It should be roasted very slowly, so that the inner parts may be perfectly done. The loss of weight—nearly altogether water and fat—in roasting is greater by nearly one-third than that sustained by boiling. Aromatic materials are developed by roasting, which are very grateful to the sense of smell; and this form of cooking certainly produces the most agreeably flavoured food. The occasional addition of flour to the surface (*dredging*) stops up the pores, and restrains the too rapid escape of the fats. Roasted meat is not so well adapted as boiled meat for sick and delicate persons, as it is apt to contain acrid substances formed out of the highly heated fats. Broiling is a species of roasting, but it produces in general a somewhat more digestible food for the dyspeptic.

Baking is sometimes found a convenient mode of cooking meat; but the dishes prepared by that process often have a rank flavour, which renders them inadmissible in the case of the sick and dyspeptic. Improved ovens for baking meat are *coming into use*: they have ventilating openings through

which the volatile matters discharged from the dishes are got rid of; the flavour of the meat baked in this way is not so rank.

Fried meat is, perhaps, the worst form in which this food could be given to the sick, as it almost invariably contains a most acrid substance, termed *acrolein*, and various unpleasant fatty acids.

Stews and hashes are generally very savoury, but they seldom agree with people of weak digestion. When made from fresh meat, they are infinitely superior to the dishes made of re-cooked meat. The repeated cooking of any kind of food greatly injures its nutritive properties; for this reason, it is better to re-heat our good cold beef and mutton in our stomachs rather than in our frying-pans or stewing pots.

The only drawback to the cooking of meat at a low temperature is the danger that it may contain trichinæ or other parasites capable of existing at a temperature of 150 degs. If, however, the meat be cooked until all traces of redness have disappeared, it is extremely unlikely that it would still contain living animals. Meat may be cooked at a high temperature, and still remain underdone; whilst, even at a heat of 150 degs. it may be too much done. The thorough cooking of foods depends more upon the duration of the process than upon the temperature to which they are exposed.

Salted meat is not so nutritious as the fresh article, because much of its saline constituents pass off in the brine. Scurvy is produced by the continued use of salted meat without fresh vegetables. It is said that meat sometimes becomes poisonous by being cured in brine that had been used several times; the pickle jar should, therefore, have its contents frequently renewed.

CHAPTER XII.

DIGESTION.

Food cannot become part of the living body, nor can it even enter the blood, until it has been subjected to the various processes termed collectively *Digestion*. These processes are:—*Mastication, Insalivation, Deglutition, Chymification, Chylification*, and *Sanguification*.

Mastication, or chewing, is, in relation to digestion, a much more important operation than it is generally considered to be; for, if food be not properly put through this preliminary preparation, the following processes are not so likely to be thoroughly carried out. So admirably adapted is the structure of the teeth to the nature of the work they re intended to perform, that it is easy to learn, from an inspection of an animal's teeth, what kind of food it subsists upon. Man has 32 teeth—namely, 8 *incisors*, or front teeth; 4 *canines*; next, 8 *pre*, or *false molars* (*bicuspids*); and, nearest the angles of the jaws, 12 *true molars* (*Multicuspids*). The set of teeth in the lower jaw corresponds with that in the upper one. In carnivorous animals the canines* are very large and pointed, and are used as weapons of offence; and the incisors, or nippers, are employed for cutting or tearing their prey into pieces. In the *herbivoræ*, or vegetable feeders, the canines are generally either absent or imperfectly developed. The molars are intended to grind food, and consequently they have broad and rough crowns. The teeth of the carnivores, corresponding to the molars in the herbivores, are cutting teeth. The premolars are intermediate, in their structure and uses, between the cutters and grinders. The vegetable feeders require incisors for the

* *From canis*, the Latin term for dog, because they are largely developed *in that animal.*

purpose of cropping or cutting herbage, but in some animals —the ox, for example—these teeth occur only in the lower jaw. The jaws of the flesh eaters open and close like a pair of scissors, because their teeth have merely to nip or cut their food; but by means of the more complicated mechanism of the jaws of the vegetable feeders their molars are enabled to rub over each other in a manner which resembles the motion of millstones. In his dentition man resembles both the flesh eaters and the vegetable feeders. His sharp incisors and canines cut to pieces the animal food which he uses, whilst his molars grind into a pulp tough vegetable food—which the teeth of the most powerful tigers or lions could not properly prepare, even if their stomachs were capable of digesting it. The theory that man is not naturally a flesh eating animal, to which "vegetarians" pin their faith, finds no proof in the structure of their own teeth and stomachs.

The great bulk of a tooth consists of *dentin*—a hard and languidly vital substance, enclosing a sensitive *pulp*. A thin layer of a very dense substance, termed *enamel*, invests the dentin, and outside of all there is a thin casing of a hard substance called *cement*. Enamel is so nearly a pure mineral body, that it contains 97 parts of earthy matter, chiefly phosphate of lime (tricalcic phosphate), whilst dentin contains only 72 per cent. of inorganic salts.

Unless the teeth are sufficiently numerous and effective, chewing cannot be properly performed, and indigestion, in one or more of its many forms, is a probable result. It is clear, then, that the condition of the teeth should be carefully attended to, beginning at the period of early childhood. From constitutional causes, many persons begin to lose their teeth in early life; but it is often in the dentist's power to arrest or lessen their decay, *provided* his assistance be timely procured. Most people try to get their teeth repaired when

only mere shells of them are left. Very cold or very hot drinks injure teeth; and they are not improved by using them as nut-crackers. It is probable that very acid drinks occasionally dissolve the enamel, and, consequently, hasten the decay of teeth. Sour gases and liquids ejected from the stomach unquestionably produce a bad effect on the teeth. The tooth brush—not too hard a one—should be used morning and night; for food left in close contact with the teeth, and unremoved *tartar*, are common causes of disease of the teeth.

Insalivation is the lubrication, or moistening of food by means of a liquid formed in the mouth, and termed *saliva.* This substance consists of a liquid secreted by little vessels termed (follicular) glands—which stud the mucous, or moist surface of the mouth, lips, gums, and tongue—mixed with liquids, prepared more abundantly by three pair of larger vessels, termed the *parotid,* submaxillary,*† and *sublingual*‡ glands. Saliva is colourless, odourless, and tasteless, and is of about the consistency of very thin mucilage. It contains less than one per cent. of solid matter, the rest being water. A nitrogenous and very fermentisible substance, termed *ptyalin,*§ or *salivin*, is found in saliva, and is the active principle of the liquid. It possesses the property of converting the starchy part of food into sugar, whereby it is rendered soluble, and more capable of being digested. The saliva of infants does not contain ptyalin, because the food which nature has provided for them—namely, milk—contains no starch. A saline matter, termed sulphocyanide of potassium, occurs in saliva; but its functions are unknown.

The formation of saliva takes place incessantly, and large quantities of it are swallowed involuntarily. Its secretion is

* A term derived from the Greek words, *para.* near, and *otos*, the ear.
† From the Latin words, *sub*, beneath, and *maxilla*, the jaw.
‡ From *sub*, and *lingua*, the tongue (Latin).
§ From the Greek word, *ptyolos*, saliva.

stimulated by the contact of food with the mouth, and even by the sight or smell of savoury dishes. Smoking tobacco causes a great waste of this liquid. It is difficult to estimate the daily quantity of saliva secreted by man; but it is believed to amount to about from 40 to 50 ounces in the case of an adult man. The saliva of flesh eating animals acts merely mechanically—that is, it moistens the food, so that it may easily pass into the stomach. As there is no starch in their food, there is very little ptyalin in the saliva of the carnivores. On the other hand, as the food of the herbivores is largely composed of starchy matters, their saliva contains a large amount of salivin; so that mastication in their case is a species of true digestion.

Deglutition, or swallowing, is the operation by which food is transferred from the mouth to the stomach; and, like all the processes in the animal economy, it is accomplished by the most beautiful and wonderful contrivances. All that need here be said relative to deglutition is, that the hasty swallowing of food is a common cause of indigestion. The Americans, who, perhaps, more than most other people eat very rapidly, suffer greatly from various forms of dyspepsia. The *bolting* of our food is, beside being injurious to health, a most ungraceful habit, placing those who give way to it almost—in the matter of feeding, at least—on a level with the ravenous beasts of prey. Man's food is, to a great extent, vegetable, and we should imitate the example shown us by the slow feeding herbivores.

In the stomach the food is subjected to the action of the *gastric juice*. This liquid—which is prepared by glands lying in the mucous lining of the stomach—is clear, limpid, slightly viscid, and possessed of a faintly acid flavour, when abundant. In some diseases, and during abstinence from food, the gastric juice is generally alkaline, or soda-like. In the gastric juice, as in the saliva, there is a nitrogenous

active principle termed *pepsin*. It does not appear to exert any influence upon the starchy food; but it is capable of dissolving the albuminous aliments of both vegetable and animal origin. Rennet owes its power of coagulating the casein of milk to the pepsin which it contains. The action of pepsin upon fats is not clearly known, but it is certainly very slight; whilst it has no influence upon starch. In the stomach of the flesh-eating animal there is abundance of pepsin; whilst it is rather scanty in the digestive organs of the vegetable feeders. In the gastric juice of the pig—which is a semi-carnivorous animal—there is a considerable proportion of pepsin; and it is from the stomach of that animal that this substance is prepared—for pepsin has recently become a commercial article, and is prescribed by the physician. The quantity of gastric juice secreted by man is very large, and is believed to amount to more than twenty pints per day. Grunëwaldt found that a woman suffering from a gastric fistula secreted thirty-one pints in twenty-four hours. Of course, a large proportion of the gastric fluid poured into the stomach is re-absorbed, or, at least, its watery constituent is; otherwise man would consume much more water than he now drinks.

Although strong acids—alkalies and alcohol—destroy the digestive power of *pepsin*, a moderate degree of acidity in the gastric juice appears to be essential to its proper action. The stomach always contains free hydrochloric acid, and generally a smaller proportion of lactic acid. Lactic acid is the sour matter which is found in milk when it becomes stale, and hydrochloric acid is the well-known muriatic acid, or spirits of salt of commerce. At low temperatures solution of pepsin (or the gastric juice) scarcely affects food; but at about blood heat (100 degs. Fah.) it acts energetically. Heated beyond 120 degs., pepsin rapidly loses its digestive power. From this we learn that very hot drinks should not

be taken, as they diminish the activity of the digestive function. If we place a piece of flesh, raw or boiled, in a warm solution of pepsin, containing a few drops of muriatic acid, it will soon be reduced to a pulp. This process is called artificial digestion, and will be referred to further on.

According to Meissner, albuminates are broken up by the action of the gastric juice into two classes of substances, which he names *peptones* and *parapeptones:* the former are digested in the stomach; but the parapeptones are not further affected until they have passed out of the stomach into the duodenum.

In addition to being acted upon chemically by the juices of the stomach, food is subjected to a mechanical treatment by the muscular coats of that organ. The food is churned about in such a way that it makes complete revolutions throughout the whole extent of the stomach, until it is reduced to a semi-liquid condition.

The final result of the action of the stomach upon food is to convert it into a whitish, rather thin pulpy substance, termed *chyme.** Part of this body is directly absorbed by vessels in the walls of the stomach; but a large portion passes into the lower intestines, where it is converted into *chyle.*

The narrow tube into which the stomach merges at its lower, or *pyloric* extremity is termed the small intestine (we should rather say narrow, for it is 25 feet long, whilst the large, or wide intestine is only from 5 to 6 feet in length); it is divided into the *duodenum*, which is nearest the stomach, and is about a foot long, the *jejunum* and the *ileum.* The surface of the duodenum resembles that of the stomach, and into this tube three distinct fluids are poured: namely, a kind of mucus secreted by the intestine itself; *bile,* which

* From the Greek word, *chymos*, juice.

receives from the liver; and the *pancreatic juice*, a contribution from a separate organ, termed the *pancreas*. The intestinal mucus is a colourless or slightly yellowish fluid; it is viscid and possesses a feeble alkaline reaction. It is asserted that this secretion combines in itself the properties of saliva and gastric juice; but as it contains no active principle like pepsin, it is singular that it should be capable of converting albuminates into peptones. Perhaps the action upon food attributed to intestinal mucus may be really due to the gastric juice, which often passes along with the semi-digested food into the duodenum. The action of the mucus upon starch may be due to its abundant nitrogenous, or albuminous constituents acting as a ferment in the way that the fermenting nitrogenous matter in dough changes its starch into dextrin and sugar.

The pancreas is a large gland situated close to the stomach: in some of the animals used as human food, it is termed the "sweetbread." It secretes a liquid termed pancreatic juice, which is constantly discharged into the duodenum. This juice is colourless, rather viscid, and very alkaline. It contains an active principle termed *pancreatin*. Its solid ingredients vary from $1\frac{1}{2}$ to $2\frac{1}{4}$ per cent., and include a large proportion of soda. Pancreatic juice helps to complete the digestion of the food which escapes the action of the saliva and gastric juice. It changes starch into sugar, but there is reason to doubt its alleged digestive action on albuminates. There are strong reasons to lead us to believe that the digestion of fats—bodies upon which saliva and gastric juice have little influence—is chiefly effected by the pancreatic secretion. Some physiologists, however, deny that pancreatin is concerned in the digestion of fatty foods; but as this juice is largely secreted by carnivorous animals, whose food contains no starch, it is reasonable to infer from *that fact that* it plays some important part in the digestion

of either fatty or albuminous food, and most probably the former.

The third fluid found in the duodenum is the product of the largest organ of the body—the liver—and is termed *bile* This substance is a slightly alkaline, but sometimes neutral liquid, of which an adult man probably secretes about 5 pints each day. Ox bile—the kind which has chiefly been examined—contains 10 per cent. of solid matter. Bile includes peculiar resinous and colouring matters, and is rich in soda. Its colour is yellowish green, or, when diluted, a deep yellow; and its flavour is intensely bitter. The liver purifies the blood and separates from it the materials which it elaborates into bile. The latter fluid is discharged through a passage (the *ductus communis choledochus*) into the duodenum, where it is partly absorbed into the food and partly passed down into the lower intestines to be got rid of. Much has been written relative to the functions of the bile; but the part which it plays in digestion is not as yet thoroughly known. It appears to act upon the fatty parts of the food, and it probably prevents the starchy matters from fermenting. Bernard found that the blood leaving the liver contained more fat than when it entered the organ; from which it would appear as if the liver were a fat-forming organ. Perhaps the starch which is changed into soluble sugar by the saliva and the juices in the duodenum is afterwards converted into fat by the liver. It is now clearly established that animals can be fattened on a diet from which fats are excluded when the elements of bile are in excess in the blood; and should the bile secreting functions of the liver be suspended, the digestion of the food cannot be perfectly performed, the blood becomes impure, a state of disease intervenes, and the patient is said to be "bilious." Sometimes the bile is secreted, but not allowed to escape: under such circumstances its accumulation in the body produces jaundice

The final action of the juices in the duodenum is to convert the chyme into a more highly elaborated substance, termed chyle. The surface of the duodenum and of the whole of the digestive canal is studded with immense numbers of minute points, termed *villi*;* they are the extremities of little ducts, or passages, through which the assimilable part of the chyle is absorbed and transmitted to little tubes, termed *lacteals*, because they contain a milk-like (*lac*, Latin for milk) fluid, and which are situated in the walls of the intestine. There are numerous other little vessels in the walls of the intestine, containing the blood, with which the structure is nourished. The lacteals, by uniting, form a network of vessels, situated within the fold of the *mesentery*, or membrane that connects the intestines with the wall of the abdomen, and serves to detain them in their proper place. They next enter little vessels, termed the *mesenteric glands*, of which there are from 100 to 150. In these vessels the fibrin and corpuscles of the chyle increase, and the substance acquires a higher degree of organization. The vessels which convey the chyle from the mesenteric glands gradually unite, forming branches, which, coalescing and growing larger, at length produce two or three large tubes, which discharge their contents into a long pouch, termed the *receptaculum chyli*. From this pouch the now highly organized material is conveyed through a tube, called the *thoracic duct*, upwards and along the course of the back-bone, until it reaches the great blood vessel, called the aorta; behind which it passes to the left side and pours its contents into a large vein the (subclavian), at a point where it joins the internal jugular vein. The diameter of the thoracic duct is about the quarter of an inch. During its passage from the duodenum to the subclavian vein the chyle becomes more and more highly

* From the Latin word, *villus*, shaggy hair.

organized, until finally it merges into and becomes an integral part of the blood.

The parts of the food which cannot be absorbed by the lacteals are passed downwards and transferred to the large intestine. The surface of the lower intestines possesses absorptive but not digestive powers.

CHAPTER XIII.

DIETETICS, OR REGIMEN.

The proper food for the newly-born infant is the milk of its mother. This nutriment should not be withheld, except for very sufficient reasons, and in obedience only to the strict orders of the physician. If the mother's milk be not available, the best substitute for it is that provided by a healthy "wet" nurse. Thousands of infants are satisfactorily fed from their birth upon a diet altogether destitute of human milk; but those children usually possess strong vital powers. It is the infants who are naturally delicate, or puny, who most suffer from the want of the nourishment intended by nature for their use. Nearly 50 per cent. of the children born in these countries die before they attain five years of age; and this excessive mortality is in great part due to defective nutrition, and to the use of unsuitable food.

The diet of the wet nurse should be abundant, nutritious, and plain. Persons in that position of life are not accustomed to dainties, and, therefore, any very marked change in their diet is more likely to prove injurious than beneficial. The vulgar idea than a wet nurse could hardly drink too much porter is a most erroneous one. She should be altogether prohibited from taking ardent spirits, or even wine, and her

supplies of malt liquor should be limited to two small bottles a day as a *maximum* quantity. Of good milk she could hardly drink too much, and she should be supplied with abundance of plain animal food. Of tea or coffee she should partake sparingly, and these beverages should be rather weak.

Those ladies who are able to nurse their infants should use a generous diet, and more especially should they drink plenty of good milk, if they can get it—for in towns that liquid is almost invariably adulterated with water. With respect to alcoholic liquors, I am inclined to think that nursing mothers are rather too liberal in using them—not from actual fondness for them, but because they believe them to be necessary adjuncts to their ordinary diet. There are delicate nursing mothers who are unable to consume sufficient food wherewith to supply their own wants and those of their infants. Those mothers are often undoubtedly benefited by a liberal allowance of malt liquors, which they are able to digest, and which, to a great extent, perform the functions of food.

In the absence of human milk, that of the cow or the ass should be used—the former diluted with one-third of its volume of water, and slightly sweetened. The milk of the goat is more liable to coagulate than that of the cow or ass, and it should not, therefore, be given to very young infants.

The saliva of infants contains little or no ptyalin, and it is, therefore, incapable of converting starchy food into dextrin and sugar. Special foods containing nutritive matter in a state adapted to the digestive organs of infants are now largely manufactured. "Liebig's Food for Infants," prepared by Messrs. Savory and Moore, is much recommended by medical men. According to Dr. H. Barker, it "resembles mothers' milk as closely as possible." The "Concentrated Patent Milk Company of London" prepare a food for infants,

which consists chiefly of "flour transformed into dextrin and grape sugar by Liebig's process." All these kinds of foods must be regarded as very valuable additions to the dietaries of the nursery.

Some children are confined to a milk diet until they are a year old; but there does not appear to be any merit in this practice. After two months it will, with few exceptions, be found advantageous to give something in addition to milk, either rusks (in the form of *panado*), or preferably one of the foods prepared specially for the use of infants. I am strongly of opinion that infants at three months old would be benefited by the use, in very moderate quantity, of weak beef tea or chicken broth. These foods, if necessary, may be given from the feeding bottle. Feeding children from a bottle provided with an artificial teat is now very general; but it often fails in the case of sickly and feeble infants. It often fails, too, in the case of healthy children, because the bottle and its appendages are not kept sweet and clean. Whilst one bottle is in use another should be steeping in water.

Human milk has a temperature of about 100 degrees, therefore it is obvious that the milk of the cow when given to infants should be warmed to from 98 degs. to 100 degs. Fahrenheit. Why should there not be a little thermometer in every nursery? The fresher the milk is the better; and the mixture of milk, water, and sugar should be used immediately after its preparation, as it very soon ferments. If the milk becomes even faintly sour it should be rejected.

Boys and girls require more food in relation to their size than adults, and they require to be fed more frequently. They are seldom epicures, and plain food in abundance is all they require. They should not use alcohol in any form, nor do they require tea or coffee until they are well gr- up. Children, however, as well as adults, suffer from

of variety in their diet. The health of the boys at the Duke of York's school was improved by introducing a greater variety into the methods of cooking their food. The sameness which once characterised the rations of British soldiers had a most injurious effect upon the health of the men.

As a general rule, working men appear to be quite satisfied with three ample meals a day. Breakfast should be taken early, because, after a night's rest, the stomach is usually without a particle of food. The French workmen make a great mistake in delaying their first substantial meal until noon. A cup of coffee and a morsel of bread do not afford sufficient force-producing materials wherewith to perform nearly half a day's work. Long walks before breakfast should not be taken; for, after a fast prolonged exercise unduly lowers the vital powers. If breakfast be taken at nine o'clock, a.m., then dinner should not be delayed later than three o'clock. Those who cannot dine until five or six o'clock should take luncheon about one or two o'clock. Nothing can be said in favour, but much might be alleged against, the fashionable practice of dining at half-past seven, and even eight o'clock. When dinner is taken early, the evening tea should be a somewhat substantial repast. Suppers, unless of the very lightest description, should not be eaten by those who have dined heartily. In any case they should not be taken later than two hours before bed time. A good breakfast invigorates us; but a heavy, late supper depresses our vital powers. The stomach sympathises with the brain: witness the horrid nocturnal visitants conjured by our disordered imaginations under the influence of late suppers of devilled kidneys or richly dressed lobster! It would appear as if the brain, indignant at the outrages offered to the stomach, punished the *gourmand* by unpleasant dreams and terrific visions.

According to E. Smith, the dinner of the working man should contain about 25 per cent. more nourishment than his

breakfast, and twice as much actual nutriment as his supper. Amongst the richer classes, the dinner contains at least as much actual nutriment as all the other meals combined.

Regularity in the hours of meals is a prime point in dietetics. To dine one day at five o'clock, the next day at six o'clock, and the following day two hours earlier is a practice which could hardly be sufficiently condemned. Periodicity is a great law of the universe. Our habits should, as far as possible, be brought into harmony with this law. We should rise, breakfast, dine, sup, and go to bed at regular stated hours. We need not, of course, carry such a system to an extreme degree; but, as a general rule, regularity in our habits of living exercises a most beneficial effect upon the health. Violent exercise or a bath after a full meal is undesirable. Rest promotes digestion. After a long fast, food should be very slowly eaten; indeed, under any circumstances we should not eat hastily. The craving for food is not instantly allayed by the introduction of it into the stomach; hence, if a meal be swallowed in a few minutes, more food may be consumed than is actually required. A full meal requires from three to five hours for its complete digestion; and as the stomach, like all the other organs of the body, requires rest, one meal should not be taken until an hour or so after the previous meal has probably been digested.

Less food is required in summer than in winter; for, during the former season there is less difficulty in maintaining the temperature of the body.

A high temperature is a necessary condition in digestion. Solid fats remain long in the stomach before they are digested; but if liquefied, they yield far more readily to the action of the gastric juices. For this and other reasons, food is best taken in a warm state. In very warm weather this rule may be relaxed, especially in the case of liquid foods.

On the other hand, food too highly heated is apt to produce a bad effect upon the teeth, and may even injure the stomach. A fondness for very hot liquids is a vitiated taste; and it should be noted that it is almost impossible to appreciate the fine flavour of food, liquid or solid, if it is so hot as almost to scald or burn the mouth.

Delicate children, especially those who exhibit any tentency towards rickets or scrofula, are often greatly benefited by the use of cod liver oil—a substance which combines in itself both nutritive and medicinal qualities. When the glands in the neck swell and become hard, they are often reduced to a normal condition under the influence of cod liver oil. A teaspoonful three times a day will usually be found sufficient when the child is from two to eight years old. A large proportion of the "cod liver" oil of commerce is composed wholly or partly of the oil obtained from hake, ling, and other fishes. Möller's and De Jongh's oils are highly recommended by the medical faculty. When the strong flavour of the oil renders it intolerable to palate or stomach, "Fox's Palatable Cod Liver Oil" is generally tolerated; but the dose of it is double that of the ordinary kind of cod liver oil.

The rapidity with which food is digested depends upon various and varying conditions, such as the nature of the food, the kind of preparation to which it is subjected, the condition of the different organs of digestion, the quantity and the quality of the different digestive juices, and so on. It is, however, desirable to know, in a general way at least, which foods are the most likely to be digested quickly, other conditions being alike. For our knowledge on this point we are chiefly indebted to Beaumont, as he was the first to make experiments under conditions which were certain to afford satisfactory results. The object of his experiments was a man who had received a wound leading into his stomach, and which, healing imperfectly, left an opening

through which the processes going on in his stomach could actually be looked at. Beaumont made a set of experiments with the object of ascertaining the length of time necessary to digest different foods in the stomach of this man, and another set of experiments to ascertain the time occupied in digesting food in solutions (heated to 100 degrees) of gastric juice placed in phials. The relative results of both sets of experiments were found to pretty closely coincide; and they have, on the whole, been confirmed by the results of similar enquiries undertaken subsequently by other physiologists. In the following table some of the more important results of Beaumont's experiments are given:—

		Mean Time of Chymification. In Stomach.	
Foods	*Preparation.*	*Hours.*	*Min.*
Rice	Boiled	1	
Eggs, whipped	Raw	1	30
Trout, salmon, fresh	Boiled	1	30
Venison steak	Broiled	1	35
Sago	Boiled	1	45
Milk	Boiled	2	
Eggs, fresh	Raw	2	
Milk	Raw	2	15
Turkey	Boiled	2	25
Gelatin	Boiled	2	30
Goose, wild	Roasted	2	30
Pig, sucking	Roasted	2	30
Lamb, fresh	Broiled	2	30
Beans, pod	Boiled	2	30
Potatoes, Irish	Roasted	2	30
Chicken	Fricassed	2	45
Oysters, fresh	Raw	2	55
Eggs, fresh	Soft boiled	3	
Beef, lean, rare	Roasted	3	
Mutton, fresh	Boiled	3	
Bread, corn	Baked	3	15
Butter	Melted	3	30
Cheese, old, strong	Raw	3	30
Potatoes, Irish	Boiled	3	30
Beef	Fried	4	
Veal, fresh	Broiled	4	
Fowls, domestic	Roasted	4	
Ducks, domestic	Roasted	4	
Veal, fresh	Fried	4	30
Pork, fat and lean	Roasted	5	15
Cabbage	Boiled	4	30

We learn from those who have made the phenomena of digestion special studies the following general principles:—1st. That animal food is retained longer in the stomach and is more perfectly digested than vegetable aliment. 2nd. That the digestion of vegetable food is very imperfectly performed in the stomach, the labour of the operation devolving chiefly upon the intestines. 3rd. That the denser the structure of food is, the longer does it resist the action of the gastric juice. 4th. That oily and fatty substances are the most difficult to be digested.

CHAPTER XIV.

DIET IN RELATION TO DISEASE.

The upper and middle classes of society consume in general more food than is necessary for the purposes of nutrition. The excess, if it be not very great, is usually speedily eliminated unchanged, or more or less altered in composition, from the system; but occasionally it is in part retained for a considerable period, producing effects varying from a mere feeling of discomfort to serious diseases. Those who habitually indulge too freely in the pleasures of the table are peculiarly liable to derangement of the digestive organs. Excessive quantities of lean meat and of sugar appear to be more readily digested than undue amounts of fatty and starchy foods, the latter being very liable to leave—hardly altered in composition—the system. A diet composed nearly altogether of albuminates produces in a few days fever and diarrhœa. When the albuminates are continuously excessive, the liver, after a time, usually shows symptoms of disease. On the other

hand, an undue proportion of fats, starch, and sugar frequently induces obesity—which, undoubtedly, may be regarded as a diseased condition of the body.

Mr. Banting, a retired manufacturer, finding himself, though only five feet five inches in height, to weigh 202 lbs., adopted a diet which, he states, reduced his weight to 150 lbs. in about twelve months. "For breakfast," says Mr. Banting, "at nine o'clock, a.m., I take five or six ounces of either beef, mutton, kidneys, broiled fish, bacon, or cold meat of any kind, excepting pork or veal; a large cup of tea or coffee, without milk or sugar; a little biscuit, or one ounce of dry toast; making together six ounces of solid and nine of liquid. For dinner, at two, p.m., five or six ounces of any fish, except salmon, herrings, or eels; any meat except pork or veal; any vegetable except potato, parsnip, beetroot, turnip, or carrot; one ounce of dry toast, fruit out of a pudding, not sweetened; any kind of poultry or game, and two or three glasses of good claret, sherry, or Madeira—champagne, port, and beer forbidden; making together ten or twelve ounces solid and ten liquid. For tea, at six, p.m., two or three ounces of cooked fruit, a rusk or two, and a cup of tea, without milk or sugar, making together two to four ounces solid, and nine liquid. For supper, at nine, p.m., three or four ounces of meat or fish, similar to dinner, with a glass or two of claret or sherry and water, making together four ounces solid and seven liquid. For night-cap, if required, a tumbler of grog (gin, whiskey, brandy, without sugar), or a glass or two of claret or sherry."

Mr. Banting states that on this diet his weight for many years continues to be eleven stones, and that he enjoys excellent health. The food mentioned in the above extract (taken from Mr. Banting's famous pamphlet) contains barely three and a half ounces of albuminates, or an ounce less than the quantity which a well-fed brain or body worker would re-

quire. The quantity of nitrogenous matter is, however, almost as abundant as that contained in the diet of Austrian soldiers, which, according to Dr. Parkes, amounts to 3.915 ounces. The carbonaceous elements in Mr. Banting's solid food amounts to only four or five ounces, or little more than one-fifth the quantity supposed to be necessary in the case of an adult man. The liquid food taken by Mr. Banting does not contain much tissue-forming matter; but his three or four glasses of wine and "night-cap" of grog act as a partial substitute for the carbo-hydrates—that is, their alcohol serves to maintain the temperature of the body, and to develop motive power. Sparse as Mr. Banting's diet is in some respects, it is, perhaps, superior to the fare enforced amongst the monks of the order of La Trappe, who usually enjoy a fair amount of health.

Mr. Banting's diet is constructed with the view of excluding, as far as possible, the elements which contribute to the formation of fatty tissue. There is no novelty in his system—for it had been previously suggested by physiologists—but he deserves credit for the persistency with which he has brought his plan of regimen before the public, and for his successful attempt to prove, in the case of his own person, that obesity admits of an effectual dietetic remedy. Some persons have, no doubt, injured their health by adopting, in an injudicious manner, Mr. Banting's system; but, on the other hand, we believe that many persons have been benefited by imitating him in the moderation of his diet, and his temperance in the use of alcohol. At the same time, we feel quite satisfied that a hard worker—either with his brains or his hands—would require a more liberal diet than that on which Mr. Banting appears to thrive so well. The reader who desires to construct a diet on Mr. Banting's principles will be enabled to do so by consulting the tables of the nutritive values of food in Chapter IX.

In sickness the functions of the body must be maintained, and this can be accomplished by the daily expenditure of about 2 ozs. of albuminates, 10 ozs. of starches or sugars, and 1 oz. of fats. If these quantities of food be not supplied, the vitality of the whole body is maintained for a while at the expense of a portion of it; but this wasting of tissue soon reduces the system to so low an ebb that death from sheer inanition, or exhaustion takes place. In diseases such as fever, where there is a high temperature of the body, the waste of tissue is most rapid. In general the food supplied to a patient should be about one-third less in quantity than the amount which he usually consumes when in health; to give larger quantities, except under very exceptional circumstances (of which his physician is the proper judge), is a great, and often dangerous, mistake. In disorders of the digestive organs, which have, in all probability, originated in excess at the table, or in the use of unwholesome food, almost complete abstinence for a day or two is generally beneficial.

Only the most digestible food should be used in the sick room. Pork and other fat animal food, veal, lamb, salted meats, the strong-flavoured fowls (duck, goose, &c.), fish, and cheese should be prohibited. Beef tea, especially if rendered more stimulative by the addition of extract of meat, has saved the lives of thousands of patients; sometimes it is, however, given *ad nauseum*. Alternations of beef tea and chicken broth are desirable; for in the dietary of the sick room variety is a most important point. Jelly, though considered innutritious by most physicians, is, I am quite satisfied, a digestible and nourishing food, and well adapted to the sick. Chicken and tender young fowl are very digestible, and should be used whenever solid food can be administered. Milk is an excellent food, but it does not agree with every one, even in a state of health. When it agrees with a patient, he may be liberally supplied with it. Milk is hardly

suitable in fever cases. Dr. Donkin, of Newcastle-upon-Tyne, has recently stated that he has obtained the most excellent results by keeping patients suffering from diabetes, Bright's disease, and other chronic maladies on a purely milk diet. Patients who cannot use much fresh milk might be able to consume a larger quantity of skimmed milk. Children, too, with whom the rich milk of the cow often disagrees, might get on much better if a portion of the cream were skimmed off. During sickness the less butter used the better in general for the patient.

In bilious disorders eggs should not be given. In other complaints the yolk is often found to be an acceptable and digestible aliment. It should be perfectly fresh, and neither too much cooked nor the reverse. The utility of giving raw eggs to sick persons appears very questionable.

Vegetable foods are sparingly employed in the dietaries of the sick. Grapes may almost always be used; and when there is thirst, the juices of the orange, or of the lemon, tempered with a little sugar, prove useful. Esculent vegetables should not be eaten. Bread is best taken in the form of unbuttered toast, very slightly browned. Biscuits and unfermented bread are superior to fermented bread in the case of dyspeptics. Of the farinaceous foods, none are so readily digestible as those prepared from rice. Colman's "British Corn Flour" is a preparation of rice, which is specially adapted for the sick, on account of its bland character, extreme digestibility, and the well flavoured dishes into which it is easily convertible. Dr. Edward Hamilton, surgeon to Dr. Steeven's Hospital, Dublin, assures me that a patient of his, who could not retain any other kind of food in his stomach, subsisted for weeks on preparations of the British corn flour, but for which article he would have died from actual want of nourishment.

Alcohol is now largely used in the treatment of disease.

When patients utterly refuse the ordinary kinds of nutriment they not unfrequently are able to drink one or more of the many alcoholic beverages. In fever the action of alcohol appears to be most strikingly exhibited. Professor W. Moore informs me that 27 fever patients under his care during October and November, 1870, at Sir Patrick Dun's Hospital, Dublin, were liberally supplied with alcohol in the form of whiskey, brandy, or wine (or two or all of these liquids), and that not a single death occurred amongst them; though in many cases the disease (enteric, typhus, and simple continued fevers) was of the most severe type. In the case of chronic maladies, the use of alcohol, though sometimes beneficial, certainly produces less satisfactory results than attend its employment in inflammatory complaints. Here, in candour, it must be admitted that many eminent physicians deny the efficacy of alcohol in the treatment of any kind of disease, and some assert that it is worse than useless. The preponderance of medical opinion is, however, in favour of the use of alcohol as a semi-medicinal, semi-nutritive substance. In chronic maladies the best wines are those which do not contain more than 20 per cent. of proof spirit. The strong alcoholic liquors should be taken very largely diluted.

Dyspepsia is a term vaguely employed to designate a somewhat ill-defined class of diseases of the digestive organs. In a limited sense it means the abnormal condition of the stomach and duodenum, in which these organs, without being structurally diseased, are incapable of perfectly and easily digesting ordinary food. The causes of simple dyspepsia, or indigestion are numerous. Deficiency of nutriment, inferior and badly cooked food, and bad condition of the blood, are prime causes of indigestion amongst the lower classes. Undue pressure of the clothes upon the body, irregularity in the hours of meals, excessive quantities of food, imperfect masticatio severe mental and bodily exercise, great anxiety of mir

and sedentary habits, are amongst the common causes of imperfect digestion. A dyspeptic who is an idler should try active exercise as a remedy; whilst relaxation often affords immediate relief to the brain or body worker, whose labours are excessive. "One man's meat is another man's poison" is a trite but true adage. Many persons constantly eat and drink things which, though generally digestible, they well know are certain to disagree with themselves. Simply for the momentary gratification of their palate they willingly undergo hours of discomfort, if not of actual pain. Any food which disagrees with the stomach will, if constantly used, be likely to convert the occasional, into the confirmed, dyspeptic.

Flatulence is a common form of dyspepsia. Those subject to it are benefited by abstaining as much as possible from esculent vegetables. They should, however, use a little fruit, in order to supply the necessary saline ingredients of food, and which are most abundant in vegetables. Grapes and roasted apples are not likely to produce *flatus*.

Pyrosis, heartburn, or acid dyspepsia, is a very common form of indigestion. It is produced by an excess of acid (lactic, or acetic) in the stomach. It is frequently caused by a diet in which the starchy elements of nutrition preponderate; and it is, therefore, common amongst the poor. Heartburn often results from the decomposition of butter in the stomach, whereby an intensely acrid and strong-flavoured substance, termed butyric acid, is produced. Those who suffer from acid dyspepsia should especially avoid pastry, and all dishes containing highly heated butter. They should prefer a diet in which the albuminates preponderate rather than the carbo-hydrates. A bulky diet seldom agrees with the sufferer from acid dyspepsia.

Biliousness is an abnormal condition of the system which some persons believe is induced by an excessive development of bile, whilst others suppose that it is caused by

the inactivity of the liver. In general the liver has very little to do with the state popularly termed bilious—the malady being frequently caused by fermentation of food in the stomach, either from deficiency of gastric juice or from the overloading of the organ. Sometimes the duodenum becomes obstructed; and the food after partial digestion in the stomach cannot descend into the former viscus: under such circumstances the food in the stomach becomes semi-putrid, and produces nausea, headache, and even worse symptoms; occasionally the duodenum, when obstructed at its lower end, discharges bile into the stomach. Certain kinds of food, which cannot, owing to individual idiosyncrasies, be readily digested, undergo partial putrefaction in the stomach, and produce bilious symptoms. Active exertion, regular habits, and moderate diet are the best remedies for simple biliousness.

In some cases defective digestion arises from deficiency of pepsin in the stomach, or of pancreatin in the duodenum. In such cases these digestive agents may be artificially supplied. Mr. Morson prepares pepsin from the stomach of the pig; and this substance is largely prescribed as a remedy for indigestion in the stomach. The "pancreatic emulsion" is another preparation of which medical men speak favourably.

In dyspepsia, pure and simple, where there is no organic disease, change of air and scene often works wonders. Those who suffer from indigestion usually say that their stomachs are out of order—a perfectly true statement; but in a large proportion of cases the nervous system is out of order and the blood is impure. It is as much by its effects upon the blood and nervous system as by its influence upon the stomach that a sojourn in some of the health resorts of Great Britain and the Continent does good. Wonderful a machine as the stomach is, it cannot do its work without the aid of the nervous system; and if the brain and spinal cord are exhausted by overwork of any kind, they are unable to

devote to the service of the digestive organs the necessary amount of force wherewith adequately to sustain the functions of the latter. The country gentleman well knows how soon his horse would get knocked up if permitted to take a full feed after a hard day's work with the hounds; and many a dyspeptic owes much of his misery to his sitting down to dinner thoroughly worn out by the brain worry and physical fatigue of the day. All who breathe impure air and have languid respiration, are prone to have their blood loaded with impurities; and those unhealthy conditions of existence lead in many ways to indigestion. Taking all these matters into account, the dyspeptic, about to take his holiday trip, should select some place which will at once afford rest for the mind and something to gratify his eye—something to constantly engage his attention; above all, something which will induce him to take plenty of exercise in good air. Most of the places in Ireland which fulfil these conditions are on the sea coast—Bundoran, Portrush, Newcastle (Co. Down), Kilkee, and Glengariff, for example. In England there is Scarborough for those who like gay society; and Whitby for those who prefer a quieter place. Some find the high and dry inland air of Harrowgate to suit them best; and those who can afford a continental trip have the very thing they require at Homburg—that is, a variety of pleasant excursions to make and the purest air to breathe. All the advantages of Homburg avail, however, very little to the dyspeptic if he allows himself to be lured by the dangerous attractions of the gaming tables of that town.

For young men a pedestrian excursion through Connemara, the Highlands of Scotland, or the English lake districts often proves a pleasant antidote for simple dyspepsia. The exercise should, especially at the beginning of the trip, be moderate. A walk of twenty miles is equal to a day's hard work at the plough or in other laborious occupations.

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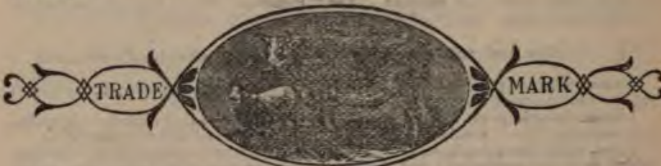

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